Coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast Districts, Western Cape, South Africa

By

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DECLARATION

I, Pili Olwethu, declare that the contents of this dissertation/thesis represent my own unaided work, and that the dissertation/thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology

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ABSTRACT

Droughts and floods are becoming more frequent globally due to climate change. In South Africa, drought has been one of the most significant disasters in recent times, with regions such as the Western Cape province among the most affected. The resultant food and water shortages have necessitated the need for robust strategies to cope and adapt, especially for smallholder farmers whose livelihoods depend on water and farming. Understanding how smallholder farmers cope in the face of drought and prepare for future droughts to minimise impacts associated with drought is crucial. This study identified agricultural water use; coping and adaptation strategies that can be adopted and implemented by crop and livestock farmers in Overberg and West Coast Districts, in the Western Cape, during the recent 2015-2018 drought. The study also analysed factors that hinder smallholder farmers from adopting beneficial livelihood strategies during drought periods.

Data were collected from 100 smallholder farmers from the two districts through face-to-face interview surveys and focus group discussions. Survey data were analysed using the Statistical Package for Social Sciences (SPSS) Version 20, while qualitative data was analysed using Atlas *ti*, Version 8.

Twelve agricultural water coping strategies were identified. In the West Coast District (WCD), smallholder farmers (SHF) mainly coped with the drought by utilising borehole water (21%), purchasing fodder (18%), and selling livestock (21%). Strategies such as grazing management (6%), limiting production (3%), and rainwater harvesting (3%) were not commonly adopted. In the Overberg District (OD), smallholder farmers mainly coped with drought through purchasing fodder (34%); they had no option but to spend their money to maintain livestock herd. They also transported water using ‘bakkies’ (27%). Other coping strategies included borehole water (7%), grazing management (7%), selling livestock (7%), and using municipal water. Strategies such as drip irrigation (3%), no-till farming (2%), limiting production (2%), and rainwater harvesting (2%) were not commonly adopted by SHFs.

About 68% and 64% of smallholder farmers in WCD and OD, respectively, had not put in place any adaptation strategies. Only 32% of SHFs in the WCD and 34% SHFs in the OD had adopted adaptation strategies. Among farmers in the WCD, adaptation strategies included storing feeds (7%), planting their fodder (5%), and installing water tanks (5%). In the OD, adaptation strategies included storing fodder (13%), storing water (5%), drilling boreholes (5%), saving money (4%), purchasing fodder (4%) and paying insurance (4%). Strategies such as conservation farming, alien plant clearance, moving livestock to secure areas, selling livestock, rainwater harvesting, and installing water tanks were not widely implemented by smallholder farmers.

In the WCD, the main factor that stopped farmers (about 80%) from adopting adaptation strategies was lack of drought awareness (80%). Other factors included lack of finance (7%), drought relief (3%), lack of water (3%), with one farmer conceding that they were not well equipped to adapt to drought. Similar to the WCD, the main factor that hindered the adoption of adaption strategies in the OD was lack of drought awareness (62%). Other factors included limited farming resources (10%), short-term planning (10%), lack of finances (3%), lack of knowledge about drought impacts and adaptation strategies (3%), and limited land (3%).

Farmers were not well informed about possible proactive agricultural water use strategies that could build their resilience towards drought. Farmers had limited options for agricultural water use strategies to choose from. A large number of SHFs had implemented no agricultural water use drought adaptation strategies. Even some of the adaptation strategies mentioned were not adopted. Results showed that farmers were generally not equipped for drought and there was a lack of public awareness of the actual occurrence of drought. Recommendations for future preparedness for crop farmers include mulching, drip irrigation, growing vegetables with shorter growing periods such as cabbage, planting of short-season crops such as maize, and changing planting dates. For livestock farmers, adaptation strategies can include drilling boreholes, altering livestock herds such as changing to goats that are resistant to drought. There is a clear need for proactive early warning systems to improve the drought preparedness for SHFs and to safeguard them from the ravages of drought.

All key players in policy implementation in the agricultural sector need to focus on smallholder farmers to build their resilience by improving drought knowledge and enhancing coping and adaptation capacities. The support could be in the form of credit facilities, involving smallholder farmers in drought resilience activities and giving relevant information and training on different drought strategies.

Keywords: Smallholder farmers, resilience, drought preparedness, crops, livestock

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DEDICATION

To my lovely parents, Flora Pili my mother and Livingstone Morris Majiyezi my father

OTHER RESEARCH OUTPUTS

Journal articles

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GLOSSARY

Agricultural water

Valipour (2015) defines agricultural water as the water withdrawn for irrigation, livestock, and aquaculture purposes. He further states that it includes water from primary renewable and secondary freshwater resources, as well as water from over-abstraction of renewable groundwater or withdrawal of fossil groundwater, direct use of agricultural drainage water and treated wastewater, and purified water. The term 'agricultural water' is used to refer to any water used for agricultural purposes or activities.

Adaptation

In human systems, adaptation is the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities. In natural systems, adaptation is the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to the expected climate (Intergovernmental Panel on Climate Change [PCC], 2012). The term 'adaptation' in this study refers to the adjustment of the farmer to minimize the impacts that drought could have caused.

Adaptive capacity

The term 'adaptive capacity' is used to describe the ability of smallholder farmers to prepare for future droughts. Adaptive capacity is regarded as the combination of strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities (IPCC, 2012).

Communal farmers

Communal farmers are defined as those farmers that have no access to storage facilities and their produce deteriorates rapidly once harvest, as a result, they receive less income compared to commercial farmers (Smith, 1989).

Coping

The term 'coping' is used to refer to the use of available strategies to overcome immediate drought impacts. The use of available skills, resources, and opportunities to address, manage, and overcome adverse conditions, to achieve basic functioning in the short to medium term is referred to as coping (IPCC, 2012).

Coping capacity

The term 'coping capacity' in this study is used to describe the ability of smallholder farmers to use available skills and resources to overcome drought impacts in the short term. IPCC (2012) defines coping capacity as the ability of people, organizations, and systems, to use available skills, resources, and opportunities, to address, manage, and overcome adverse conditions (IPCC, 2012).

Drought

The term drought in this study refers to all four types of drought. IPCC (2012) defines drought as a period of abnormally dry weather long enough to cause a serious hydrological imbalance

(IPCC, 2012). The term drought in this study refers to shortages of water and prolonged periods of below-normal rainfall and prolonged unusual dry periods and prolonged periods of shortages in water supply.

Drought awareness

The term 'drought awareness' is used to refer to the state of being aware and having knowledge and understanding that drought is coming allowing farmers to make decisions that are aligned with the most reliable available information in increasing coping and adaptation capacities (Lander and Green, 2000).

Impacts

In this study, the term 'impacts' is used to refer to the effects of drought on smallholder farmers' farming, and their livelihoods. Impacts are referred to as effects on natural and human systems (IPCC, 2012).

Livelihoods

A livelihood is the capabilities, access to assets and resources and all required activities for a means of living: a livelihood is sustainable which can cope with and recover from disaster (Chambers and Conway, 1992).

Resilience

The ability of a system and its components to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions (IPCC, 2012).

Resource-poor farmer

Resource-poor farmers are defined as those farmers with limited to no resources who are experiencing critical difficulties in sustaining their farming, families and their livelihoods (Santacoloma, 2002, Hofisi, 2003).

Smallholder farmer

The South African Department of Agriculture Forestry and Fisheries (2015) defines smallholder farmers as those farmers who produce for household consumption and markets subsequently earning on-going revenue from their farming businesses, which form a source of income for the family. Smallholder farmers have the potential to expand their farming operations to become commercial farmers. For this study, the term 'smallholder farmer' is used to refer to small-scale farmers, emerging farmers, resource-poor farmers, and communal farmers.

Vulnerability

This term is used to describe the tendency of smallholder farmers to be affected by drought. The IPCC (2012) defines vulnerability as the propensity or predisposition to be adversely affected (IPCC, 2012; UNCCD, 2016).

ACRONYMS

EC	Eastern Cape
EWS	Early Warning System
DAFF	Department of Agriculture, Forestry and Fisheries
DMA	Disaster Management Act
DWS	Department of Water and Sanitation
HFA	Hyogo Framework of Action
MDGs	Millennium Development Goals
SA	South Africa
SHFs	Smallholder Farmers
SDGs	Sustainable Development Goals
WC	Western Cape
WCD	West Coast District
OD	Overberg District
WRC	Water Research Commission

CHAPTER ONE
INTRODUCTION

1.1 Background

This study is built on previous research commissioned by the Water Research Commission (WRC) in 2016, entitled “Coping and adaptation strategies for agricultural water use during drought periods” (Report Number: KV 363/17). The project reviewed existing understanding of drought and its incidence in South Africa (SA) and identified a number of present strategies to cope and adapt to drought in rain-fed cropping systems, irrigation, livestock and mixed farming systems, mainly in SA but including a few global case studies.

The findings of the WRC Report Number: KV 363/17 showed that little is known about drought occurrence in SA. Currently, the strategies for farmers to support coping and adaptation to drought are uncoordinated and scattered over various institutions. The research found that there was a critical need in the agricultural sector to review current adopted strategies to respond to drought in order to devise and document different effective strategies for farmers to implement during times of drought (Ncube, 2017). The study concluded that there is a need to invest in building farmers’ resilience and ability to cope and adapt to droughts (Ncube, 2017), especially in the smallholder farming sector. This study built on this research. The study sought to identify and describe possible coping and adaptation strategies for smallholder crop and livestock farmers during drought periods.

1.2. Problem statement

Drought is a recurrent natural disaster that affects humanity through its impact on water and agricultural resources. In agriculture, it results in livestock mortality, crop failure, and food shortages across the world (Masih et al., 2014; Coulibaly et al., 2015; Botai et al., 2017). According to Van Zyl (2008), in the South African context drought is a persistent and irregularly dry period when insufficient water is available to meet the needs of users. Botai et al. (2017) describe four main epochs through which drought spreads. Firstly, drought occurs when there is a prolonged time with less than average precipitation for more than one to a quarter of the year as a meteorological drought. When drought conditions persist resulting in insufficient soil and subsoil water, impacting growth of crops, it is referred to as an agricultural drought. The third epoch is when a drought affects water resources such as dams and rivers by reducing water levels and this is called a hydrological drought. Lastly, when drought results in physical water scarcity that affects people’s activities is called socio-economic drought.

The African continent has been known as significantly susceptible to recurrent droughts, and the Southern African regions are the most vulnerable because of low adaptive capacity (Niang et al., 2014). If perceived changes in climate persist in the future, water sources will be severely threatened (Kusangaya et al., 2013; Serdeczny et al., 2017). The arid and semi-arid regions are already experiencing water scarcity and according to climate change forecasts, the planet will become hotter and drier in the future (Solh & Van Ginkel, 2014; Nairizi, 2017). Meanwhile, due to limited water resources, in many developing countries there is competition among water users such as agriculture, industries, and cities. This has resulted in rising demand for agricultural water use (Boutwell, 2015; Brooker & Trees, 2020).

According to the Food and Drug Administration [FDA] (2006), agricultural water is the water that is expected to directly contact the portion of the harvestable produce. Valipour (2015) defines agricultural water as the water used for livestock, irrigation purposes and aquaculture. This consists of water from renewable resources, freshwater resources, and water from renewable groundwater resources, treated wastewater, and purified water. According to the Centres for Disease Control and Prevention (CDC) (2016), agricultural water is water used to grow fresh crops, fruits, and vegetables and to sustain livestock as an important part of our diet. Among these definitions of agricultural water, the FDA (2006) definition will not be adopted as it appears to cover water used for growing vegetables and fruits and exclude the water used to raise livestock. The definitions provided by Valipour (2015) and CDC (2016) are more appropriate here – that agricultural water is water used to grow fruits and vegetables and also to sustain livestock – since participants in the study were smallholder farmers (SHF) farming with livestock, vegetables and crops.

Globally the agriculture sector uses the most freshwater, and water drawn for irrigation accounts for nearly 70% of this (CDC, 2016; World Bank, 2017). Because of water becoming scarcer, the availability of freshwater is the greatest challenge facing humanity (Sophocleous, 2004; Denby, 2013). Droughts are a recurrent phenomenon, reducing water to a scarce resource and threatening the people whose livelihoods depend on farming and the economies of many regions across the world (Solh & Van Ginkel, 2014; Alam, 2015; Mitchell & Mcdonald, 2015; Zwane, 2019). Scientists have observed that developing countries will be exposed to increasingly severe droughts in the future. Already some developing countries are experiencing devastating drought impacts, having few systems and strategies to cope with drought or prepare for the future. South Africa is no exception (Ludwig et al., 2007; Delaporte & Maurel, 2015).

In Africa, a high percentage of agriculture is rain-fed and therefore prolonged periods of droughts will seriously reduce crop yield and threaten food security, while people who rely on farming for their livelihoods will be compromised (Eriksen et al., 2008; Baleta & Pegram, 2014; Lawson et al., 2019). Climatic stressors that affect household food security and livelihoods constantly threaten smallholder farmers who practise mainly rainfed agriculture (Ahmed et al. 2016; Yiran and Stringer, 2016). SA is among the countries that are prone to drought, given that it comprises arid and semi-arid lands (Schwabe et al., 2013; Baudoin et al., 2017). The country's water sector is threatened by drought and its inevitable negative impacts (Schulze, 2016). Agriculture suffers first and most severely because it depends on climate variability and uses most of the available freshwater (Turpie & Visser, 2013; Rey et al., 2017). For centuries South Africa has been faced with drought problems, with provinces such as the Western Cape (WC) reported being still highly vulnerable to serious water shortages. The recent drought (2015-2018) experienced in the WC was the worst in 113 years (Botai et al., 2017; Mdungela et al., 2017). Drought like this affects farming productivity, resulting in the disruption of production, food insecurity and declines in income of millions of households in SA (Schulze, 2016; Masipa, 2017).

Drought poses a great risk for agriculture, food and water supplies. This is apparent in the WC, where drought continues to compromise the agricultural sector, with adverse impacts on production and water reservoirs, causing declines to below customary capacity (Delaporte & Maurel, 2015; Botai et al., 2017; Western Cape Government Agriculture, 2017). The IPCC, (2012) defines impacts as effects upon natural environments and human systems. In this study, the term 'impacts' is used to refer to the effects of drought on SHFs' livelihoods.

In the WC province, SHF are the most seriously affected by the crippling drought conditions because they lack the resources to deal with the impacts of drought (Midgley & Methner, 2016; Western Cape Government Agriculture, 2017). Faced with a severe decrease in production, and in the absence of coordinated strategies to cope and adapt to drought (Ncube, 2017), many SHFs decided to leave farming (Latham, 2016). Predictions are that the WC province will become relatively drier in the future (Western Cape Government Agriculture, 2017). Meanwhile, the significant demand for agricultural water use continues. According to Ncube (2017) and Nkhuoa (2017), 60% of freshwater is used in agriculture, most of it for irrigation.

Several studies have shown that farmers are aware of changes in climate, and these observations are similar to various scientific assertions from models and empirical evidence. The fourth and fifth assessment reports of the Intergovernmental Panel on Climate Change (IPCC, 2012) estimate a 5% decline in rainfall by 2050, accompanied by increasing temperatures. Farmers will thus become more vulnerable in the future (Solh & Van Ginkel, 2014). According to Eriksen et al. (2008), vulnerability is the extent to which a social or natural system is in danger of continuing harm from climate change, as results of exposure, sensitivity and coping capacity. The IPCC (2012) also characterises vulnerability in terms of the susceptibility to be adversely affected. This term is therefore used to describe the tendency of SHFs to be affected by drought. Communities in developing counties, in particular, are increasingly vulnerable to drought, and there is an urgent need for them to learn to cope with this eventuality (Wijaya, 2014; Delaporte & Maurel, 2015).

Droughts are becoming more severe and will have devastating impacts on food security and the livelihoods of many farming communities in arid and semi-arid areas (Solh & Van Ginkel, 2014). There is consequently a need to identify and adopt coping and adaptation strategies to minimise the effect of these impacts on the agricultural sector (Schulze, 2016; Botai et al., 2017). This will help farmers to survive and prepare for future droughts rather than simply abandon the land.

Schulze (2016) says that water resources in the WC region are at risk, and unless urgent measures are taken to conserve the little available water, the area will run out of water. In past years, droughts were seen as an unusual phenomenon simply to be tolerated with some mitigation until things returned to normal. However, it has been recognised that mitigation of the effects of drought requires massive investment, time-consuming, and very difficult to implement. Now, because of increased vulnerability in various countries, adaptation has been recognised as the main strategy to deal with the impact associated with natural disasters. Farmers are thus advised to adapt to the changing environment in their daily farming practices if they are to sustain their livelihoods (Alam, 2015; Delaporte & Maurel, 2015; Smith-Helman, 2017).

Since drought is considered a climatic disaster that cannot be prevented, Solh and Van Ginkel (2014) advise that farmers should learn to cope and adapt to it. Eriksen et al. (2008) define coping as comprising the immediate actions taken in the face of the disaster as a measure of one's capacity to sustain one's livelihood. The IPCC (2012) defines coping as the use of available skills, resources, and opportunities to manage, and overcome adverse conditions, to achieve basic functioning within the short to medium term (IPCC, 2012). Therefore, both definitions – by Eriksen et al. (2008) and IPCC (2012) – will be adopted to the extent that they construe coping as a short-term strategy adopted to minimise the immediate impacts caused by disaster by making use of available resources and skills. In contrast with coping, adaptation is defined as comprising adjustments in practices and processes made to minimise potential impacts associated with climatic disasters. This includes measures to reduce the sensitivity of a system, such as undertaking actions that will make agriculture less drought-sensitive (IPCC, 2012). For the purposes of this study, the term 'coping' is used to refer to the use of strategies adopted to overcome immediate drought impacts, while the term 'adaptation' is used to refer to long-term adjustments that will moderate potential or future impacts.

Droughts are predicted to become more extreme in the future, and therefore planning for and adapting to drought is seen as a more proactive option than crisis management. When drought strikes, most SHFs lack the capacity to implement appropriate strategies (Mitchell & McDonald, 2015). The capacities include coping capacity, which is the capacity to prepare for predicted disasters, act when the disaster takes place and recover from its impacts, through various options to access food and income when agriculture fails (Eriksen et al., 2008). According to the Intergovernmental Panel on Climate Change (IPCC, 2012) coping capacity is the capacity of institutions, communities and systems to overcome extreme conditions through the use of available resource and skills (IPCC, 2012).

Adaptive capacity, on the other hand, refers to the capacity to institute adaptation; the capability of a system to alter practices, procedures or structures to moderate the potential harm caused by climate change (Eriksen et al., 2008). The IPCC (2012) defines adaptive capacity as a combination of available skills, strengths, attributes and resources to communities, institutions and individuals that can be used to plan for and act during extreme events to minimize impacts associated therewith. The term 'coping capacity' used in this study, therefore, refers to smallholder farmers' ability to utilise available resources to cope with immediate drought impacts (Sungay et al., 2010). The term 'adaptive capacity' is used to refer to the ability of SHFs to prepare for future droughts in such a way as to reduce the negative impacts of that drought.

Lack of coping and adaptive capacity among SHFs in SA is exacerbated by the fact the country does not have safety nets for SHFs during drought periods. This exacerbates their vulnerability to drought conditions. SHFs have been trying to cope with drought for decades but the measures they have taken are reactive strategies (such as transporting water with containers from the source) and thus they have failed to cope and adapt (Mukheibir, 2007; Schulze, 2016).

Due to prolonged droughts, the small rivers on which many SHFs depend are drying up, threatening water supply in the future. Many SHFs are dependent on borehole water for their livestock, but groundwater is often too salty and of poor quality for irrigation purposes (Schulze, 2016). Predictable increases in the frequency, duration, and intensity of drought conditions are likely to reduce crop yields and livestock productivity. The decline in yields may affect household income in agriculture-based economies and can affect total economic growth (Schulze, 2016). There is, therefore, a need for proactive strategies at local and national levels to deal with the impacts of drought (Brink, 2015; Gerber & Mirzabaev, 2017).

1.3. Delimitation of the study

The agriculture sector in SA is dualistic: it includes a well-integrated, highly capitalised commercial sector with roughly 35 000 white farmers and 5 000 black farmers, generating around 95% of agricultural output on 87% of all agricultural land; and a smallholder sector which includes around 4 million black farmers cultivating in the former homeland regions on 13% of the agricultural land (Pienaar & Traub, 2015; HarvestSA, 2018). Commercial farmers are in an impossible position of striving to feed about 55 million people, since the last count. In terms of production, the smallholder sector is relatively small compared to the commercial sector and it is faced with many challenges (Pienaar & Traub, 2015; HarvestSA, 2018; Sebopetsa, 2018), including the effects of disasters such as drought (Harvey et al., 2014).

The South African Department of Agriculture, Forestry and Fisheries (DAFF, 2015) characterizes smallholder farmers as farmers who produce for household consumption and market any surplus as a source of income for the family. These farmers have potential to extend their production to farm commercially. This suggests that the category should, therefore, be subdivided into two, emerging farmers and smallholder farmers. The term emerging farmer refers to those farmers who market their produce, while smallholder farmer refers to all farmers who produce for family consumption (Pienaar & Traub, 2015). However, for this study, the term 'smallholder farmer' will be used to refer to small-scale farmers, emerging farmers, resource-poor farmers, and communal farmers.

Currently, SHFs in the WC province are in general not well equipped to handle the extent to which the agricultural sector is threatened by the present and future droughts (Schulze, 2016). This implies that current strategies adopted by SHFs to cope and adapt to drought should be identified and described. Doing so will help reveal how they can be improved to be capable of minimising drought impacts, lower smallholder farmers' vulnerability and build their resilience in the face of drought (Kiem & Austin, 2013). Resilience is defined as an active procedure of maintaining effective coping and adaptation strategies in the face of harsh conditions (Allen et al., 2011). The term will be employed to refer to the capacity of SHFs to endure and recover quickly from drought conditions.

Droughts are negatively affecting the agricultural sector in SA, a sector recognised as contributing more than other sectors to the overall growth of income where vulnerable populations live and work. The agricultural sector plays a huge role in poverty, malnutrition and famine reduction by increasing and improving food supply, access and a better diet. All South Africans, including commercial farmers and most SHFs, are already managing devastating drought impacts. Smallholder farmers in SA who are dependent mainly on rain-fed agriculture are particularly vulnerable to droughts and this trend will continue as the country becomes warmer in the future (Gbetibouo et al., 2010; Ubisi et al., 2017). Current information shows that drought will have devastating impacts on water sources and food security, and therefore the sector has to develop and implement strategies that will protect its various components. Continuous and robust support is required to help farmers to deal with threats posed by droughts (Schulze, 2016; Vermeulen et al., 2017).

In the past, many countries including SA have focused only on mitigating drought, struggling to live with and to manage the impacts of climate variability on agricultural systems. However, the recent literature suggests that awareness of the impacts of drought and early planning to cope and adapt to droughts can help minimise their impacts on-farm productivity and protect farm operations (Mitchell & Mcdonald, 2015; Schulze, 2016).

1.4. Study objectives

The study sought to 1) Review the coping and adaptation strategies for agricultural water use adopted by smallholder farmers (with an emphasis on South Africa); 2) Identify and describe different coping and adaptation strategies for agricultural water use adopted by smallholder farmers in the Overberg and West Coast district municipalities in the Western Cape province, and 3) Analyse factors hindering the adoption of drought coping and adaptation strategies for agricultural water use by smallholder farmers in the Overberg and West Coast district municipalities in the Western Cape province. We need to understand the farmers' current strategies to be able to make recommendations on how these can be improved to be capable of dealing with drought impacts and building the SFHs' resilience in the face of drought. According to Schulze (2016), farming technologies and practices among many South African farmers are still basic, and for many, income from farming has remained quite low. Many farmers have few options in terms of adaptation to the impending adverse effects of drought, resorting to reactive rather than proactive strategies (Gerber & Mirzabaev, 2017). Strategies that are adopted to cope and adapt to drought should be strategies that will address not only current drought impacts and water shortages but also minimise future impacts and deficits (Engle & Lemos, 2010).

Identifying and describing current drought strategies will assist in ensuring that SHFs adopt proper and effective strategies to overcome drought impacts and for sustainable livelihoods (Tazeze et al., 2012; Uddin et al., 2014; Williams et al., 2019). Adaptation strategies will help farmers defend themselves against the losses associated with drought thereby ensuring sustained production and improving household food security (Tazeze et al., 2012; Douxchamps et al., 2016). Solh and Van Ginkel (2014) add that coping with and adapting to drought can help farmers to (i) prepare well to cope with drought; (ii) develop more robust ecosystems; (iii) enhance resilience to recover from drought; and (iv) reduce drought impacts and vulnerability (Le Nguyen & Nguyen, 2018).

Botai et al. (2017) caution that there are impediments associated with many of the proactive strategies that farmers might adopt to deal effectively with drought. Khapayi and Celliers (2016) therefore advise that a strong understanding of key factors that hinder the development of smallholder farmers is crucial to develop effective drought-resisting strategies. The study consequently also seeks to analyse factors that hinder smallholder farmers' capacity to implement coping and adaptation drought strategies in the Overberg and West Coast Districts in the WC. As Khapayi and Celliers (2016) affirm that, South Africa can no longer risk having development projects and policy interventions planned for supporting smallholder farmers that do not work, seemingly because the challenges faced by SHFs were not correctly identified.

1.5. Thesis structure

The thesis is divided into five chapters. Chapter one discusses the background and context of the study, the research problem and the significance of the research, delimitation of the study and the study objectives. Using the experiences of smallholder farmers in few selected countries with an emphasis on South Africa, chapter two examines the strengths and shortcomings of different coping and adaptation strategies adopted by crop and livestock smallholder farmers in response to drought. Chapter three discusses the research design and study methodology.

Chapter four presents results and discusses in detail all the findings on smallholder farmers' characteristics, land and water resources, 2015-2018 drought impacts, coping and adaptation strategies adopted by smallholder farmers in the two selected districts and lastly outlines factors that hindered smallholder farmers from adopting such strategies. Also, this chapter compares results with the Hyogo framework of action (HFA, 2005-2015) to analyse adopted strategies on whether or not are they playing a role in building smallholder farmers' resilience towards drought. Also, making use of HFA this section examines whether factors hindering the adoption of drought strategies are being reduced among smallholder farmers to encourage the adoption of such strategies.

In chapter six, the study argues that vulnerability to drought by smallholder farmers is mainly attributed to lack of drought knowledge, lack of preparedness, lack of robust coping and adaptation strategies and low coping and adaptive capacities. This study concludes that instead of promoting reliance on drought relief, smallholder farmers should be equipped to adopt proactive drought strategies. Also, the study emphasizes the need for financial reserves and contingency mechanisms for smallholder farmers to ease severe drought losses in the future

CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction

Since the beginning of time, droughts have posed a threat to the survival of people and the communities in which they dwell. Droughts have often caused massive food shortages and famines across the world, and even today continue to affect our global community in numerous ways (Wilhite & Vanyarkho, 2000). Communities and regions, which depend mostly on agriculture, are said to be the most vulnerable to the impacts of climatic events such as drought since climatic conditions are crucial to agricultural production (McLeman et al., 2008).

While droughts occur in both high and low rainfall areas, smallholder farmers (SHFs) are the most vulnerable group in arid and semi-arid lands. Droughts are becoming more frequent and more severe due to global climate change (Love et al., 2006; Moreira et al*.,* 2007; Sheffield & Wood, 2012). Climate change refers to a change in the mean or the variability of temperature and typical weather patterns in a place and that persists for an extended period, typically decades or longer, causing a rapid decrease in water resources (IPCC, 2012; Sheffield & Wood, 2012). This decline in water resources will negatively affect a large proportion of the world's population whose livelihood depends on water, mostly the rural poor whose main source of income is agriculture. Water shortages hinder development in agriculture and impact negatively on the income potential of farming in many developing countries across the world. A rapid increase in competition for water resources is accompanied by increasing demand for irrigation water and a steadily growing population. At any one time, about a third of the people across the world will face water shortages. Changes in climate also exert a severe strain on the supply of water and its productive capacity. It seems likely that in the future, because of the demand for agricultural water, water shortages will intensify and water-related disasters will become more frequent (Namara et al., 2010; Alam, 2015).

Agricultural water is already a critical problem for our society, with droughts exacerbating the crisis of insufficiency (Pereira et al., 2002; Pereira, 2005; Boutwell, 2015) and posing risks to our limited water resources (Boutwell, 2015). The persistent climatic patterns experienced in arid and semi-arid areas have caused large-scale water and food insecurity (Misra, 2014; Masipa, 2017).

Large-scale commercial agriculture is the economic sector with the highest demand for irrigation for food production, exerting the greatest pressure on freshwater resources and accounting for about 70% of total water withdrawals. Of course, agricultural water demand varies from region to region, with high demand reported in the arid and semi-arid regions. In these regions, the water requirement for irrigation rises up to 85% of overall demand, and more

(Winkler, 2014; Kanianska, 2016; Chebil et al., 2019). Therefore, semi-arid regions are already faced with a water scarcity that is likely to intensify in the future (Mendelsohn, 2016). It is expected that competition for water resources will intensify in the near future, impacting agriculture the most (World Bank, 2017).

This chapter will define the four types of drought according to definitions by a few selected authors, Weather Services of South Africa and the IPCC. Agricultural water will also be defined since it is the focus of the study. The impacts caused by drought in South Africa and other selected countries, and in the Western Cape province in particular, will be outlined, with a focus on livestock and crop farming systems. Past drought management attempts by the South African government and farmers over the years will also be discussed. The need for the agricultural sector to learn to adopt agricultural water use strategies to cope with and adapt to drought will be discussed and emphasised. Lastly, hindrances that impede the strategies that farmers use to cope with and adapt to drought will be identified.

2.2. Drought definition

Drought is a natural risk different from other climatic events to the extent that it is characterised by slow occurrence and affects a large population. It is difficult to determine when a drought will occur or when it will end, or how severe it will be (Wilhite et al*.,* 2005; Wilhite et al., 2014). Botai et al. (2017) agree that the inherent difficulties in predicting a drought's onset and its duration enable it to affect a large population.

Sun et al*.* (2006) define drought as a disaster characterised by precipitation below the average over a short to long period. It is seen as a temporary period of dryness, unlike permanent aridity in arid regions. Drought can occur anywhere in the world, including in wet and tropical areas. Dai (2011) therefore defines drought simply as a period that is drier than normal, while Botai et al. (2017) insist that it is a natural disaster that affects the entire community.

Several authors argue that drought spreads through four main phases (Wilhite, 2000; Tallaksen & Van Lanen, 2004; Botai et al., 2017). Drought originates as a *meteorological drought*, which Dai (2011) defines as a period of below-normal precipitation taking place over months or years, normally accompanied by high temperatures and likely to lead to the occurrence of other droughts. For Botai et al. (2017), *meteorological drought* is a period of lower than normal precipitation over a period of only one to three months.

Persistent precipitation deficiency that results in crop damage is called *agricultural drought* (Fauchereau et al., 2003). Dai (2011) defines *agricultural drought* as a period where the soil becomes very dry because of lower levels of precipitation, variable rainfall and high levels of evaporation, causing a decline in crop production and plant growth. Botai et al. (2017) also define *agricultural drought* as a prolonged period of below-normal precipitation that results in insufficient soil water and subsoil water, impacting negatively on crop production.

The third type is called *hydrological drought*. It is associated with a shortage of precipitation over a long period, from 12 months to two years or more. Impacts associated with this type of drought are more noticeable on surface and subsurface water supply (Fauchereau et al., 2003). When river flows and the storage of water in resources such as aquifers and lakes decline to below normal capacity, the result is a *hydrological drought* (Dai, 2011). This type of drought happens slowly and over a long period due to the gradual depletion of stored water that is not refilled. In sum, *hydrological drought* reflects reduced levels of water in water resources (Botai et al., 2017).

Lastly, when the availability of water compromises human activities, it is referred to as *socioeconomic drought* (Botai et al., 2017). In this study, the term drought is used to refer to all four phases of drought described above; or, in brief, drought is a dry period due to below normal rainfall, causing declines in the water supply and leading to deficits in agricultural production.

The IPCC report (2012) usefully summarises the definitions given above by characterising drought as a period of abnormally dry weather long enough to cause a serious hydrological imbalance. *Meteorological drought* is a drought caused by abnormally low precipitation, causing changes in soil moisture and groundwater. *Agricultural drought* is a shortage of precipitation during the growing season and therefore affecting crop production, while *hydrological drought* is a drought that depletes supplies of stored water. The South African Weather Service prefers not to categorise drought but rather assess it on the basis both of the degree of dryness in comparison to normal or average amounts of rainfall for a particular area or place, and the duration of the dry period.

2.3. Agricultural water

According to Newton et al. (2003), agricultural water normally centres on the large cross-section of irrigation withdrawals by cropping systems. Valipour (2015) defines agricultural water as the water withdrawn for livestock production, the irrigation of crops and aquaculture activities. It includes primary water resources that can be renewed and freshwater secondary resources, as well as water from renewable groundwater resources, treated wastewater and purified water. The Centre for Disease Control (CDC) (2016) defines agricultural water as the water that is withdrawn to raise livestock and cultivate fresh produce. This study adopted the definitions of agricultural water proposed by Valipour (2015) and the CDC (2016) because it focuses on both crop farming and livestock farming. For this study, agricultural water use, therefore, refers to water used for the irrigation of crops and livestock production.

Pereira (2005) identifies agricultural water use as one of the main, if not the main user of water that faces severe competition from non-agricultural users. Irrigation abstractions represent about 70% of total freshwater use. Of this water, it is reported that only half reaches its intended recipients, the rest being lost during abstraction (Knox et al., 2012).

Known as one of the driest continents, Africa is experiencing extreme water disasters. Batino and Waswa (2011) claim that over 90% of economies in Africa are closely linked with natural resources, mainly through agriculture, which depends heavily on climate conditions. It is predicted that across Africa rain will decline by about 10%, reducing drainage by 17%, by the year 2020. This rapid increase in climatic variability causes an increase in the magnitude of droughts. This in turn results in a decline in agricultural production, while demand for food continues to increase because of the rising population. Because the agriculture sector is reported to utilize about 70% of all the water that is withdrawn globally, agricultural water use is the main issue in water-related discussions, together with the question of food security (Serdeczny et al., 2016; World Bank, 2017).

2.4. Drought globally and in Southern Africa (including South Africa)

In Southern Africa, drought is a natural hazard that occurs frequently and is part of the region's climate. Agricultural production in Southern Africa is associated with drought patterns. Climate projections and scenarios have however been suggesting a rapid increase in the frequency of drought, particularly in the winter-rainfall region of Southern Africa in the future (Hoffman et al., 2009; Serdeczny et al., 2016). Recently, widespread and severe droughts have been experienced in many different countries in the Southern Africa region. Intense droughts were experienced during 1982–1984, 1991–1992 and 1994–1995. Devastating ecological impacts, as well as socio-economic impacts, were experienced in the region during these years (Masih et al., 2014; Baudoin et al., 2017).

In accordance with the Fifth Assessment Report (AR5) conducted by the Intergovernmental Panel on Climate Change (IPCC), droughts are expected to increase, with devastating impacts on natural and human systems throughout the world. Availability and supply of water, food security as well as the supply of agricultural production and incomes are impacted negatively by extreme drought. This would adversely affect the most vulnerable individuals (Tambo, 2016; Kuwayama et al., 2019).

In countries where agriculture is central to the economy, the impacts caused by changes in climate are already rising. Warm temperatures and variable rainfall threaten agriculture and exacerbate its vulnerability, especially in respect of the production of food. This trend is likely to persist in the near future and result in a decline in the production of staple crops (Midgley & Methner, 2016; Abdul-Razak & Kruse, 2017).

In Southern Africa, about 70% of the population is dependent on rain-fed agriculture for food, employment and income. Because agriculture is among the sectors most vulnerable to climate variability and weather extremes, particularly droughts (Midgley & Methner, 2016; Abdul-Razak & Kruse, 2017), the threat to food security and the possibility of famine are increasing (Tambo, 2016).

Ghana is among the driest savannah regions, reporting frequent droughts. Agriculture is one of the most sensitive sectors in Ghana, employing about two-thirds of the population (Tambo, 2016), and SHFs, whose agricultural production is mainly rain-fed and who rely on agriculture for their income and food, are the most affected in that sector (Abdul-Razak & Kruse, 2017). In Tanzania, the occurrence of drought has been frequent, with its impacts becoming increasingly evident in agriculture. Droughts in recent years include the 1994/1995 and 2005/2006 droughts, which caused widespread food shortages. Another impact of the drought in the region has been a shortage of pastures, resulting in migrations among livestock farmers in search of water and grazing (Kangalawe, 2012).

In 2015/2016, the Southern African Development Community (SADC) experienced its worst drought in 35 years, associated with an acute El Niño weather phase. This drought caused significant declines in crop harvest for two consecutive seasons and about 643 000 livestock were lost. Food shortages and increased food prices destroyed the livelihoods of many and slowed down economic growth in the agricultural sector (Midgley & Methner, 2016).

In many developing regions, smallholder farmers' livelihoods are facing increasing challenges because of climate variability and their low resilience capacity towards climate change (Osbahr et al., 2008; Zwane, 2019). Droughts exacerbate poverty and constrain development in Africa. Development organisations are threatened, particularly organisations focusing on food security, poverty reduction and sustainable development. However, various sectors and individuals show the potential for resilience in the face of droughts since they are somehow able to continue or recommence and even improve their livelihoods after drought (Osbahr et al., 2008).

South Africa is the 30th driest country in the world and chronically prone to droughts. Drought is part of the South African climate in most of the arid or semi-arid regions of the country. At present, rainfall in SA is reported to be highly variable and difficult to predict during the year and between years. As a result of variable rainfall, the availability of freshwater is compromised across the country; some rivers dry up while most flow at a low level throughout the year. Although since 1965 there has been a general increase in agricultural production, several dramatic declines in production occurred from the early 1970s until the mid-1990s. These correspond to severe droughts in SA and demonstrate the vulnerability of the country's agriculture. Extreme droughts in SA are mostly triggered by El Niño Southern Oscillation (ENSO) (Mukheibir, 2007; Midgley & Methner, 2016; Baudoin et al., 2017). Periodic shortages of water are undoubtedly retarding the country's development and negatively affecting its economy (Mukheibir, 2007; Hoffman et al., 2009; Baudoin et al., 2017; Schreiner, 2018).

Reports show that the country received 403 mm of rainfall in 2015, which according to the South African Weather Service (SAWS) is the lowest annual total on record since the collection of rainfall data began in 1904. As a result, severe declines in the countries' dam levels were experienced between March 2014 and November 2016, with a mean reduction from about 93% to 48% capacity. A slight recovery was experienced early in 2017, followed by a moderate decline (Donnenfeld et al., 2018).

The agricultural sector in SA is devastated by drought because agricultural production is impacted directly by the amount of rain received (Mukheibir, 2007; Midgley & Methner, 2016). Smallholder farmers are particularly vulnerable due to their possessing insufficient resources for effective on-farm risk management (Fauchereau et al., 2003; Bahta et al., 2016; Schulze, 2016; Belle et al., 2017). Agriculture enables food security to be maintained in SA. An increase in the frequency of drought will cause a loss of jobs, threaten food security and increase food prices (Botai et al., 2017). What is more, when the ability of the country to export grain declines, the foreign income generated also declines while the demand for food imports increases. This affects the economy of the country as a whole (Schulze, 2016).

The 1991–1992 drought was the most severe experienced in SA. Severe crop damage was experienced, which resulted in huge agricultural losses. In 2015-18, severe drought was again experienced in SA, again with devastating effects across the country. According to the AgriSA Status Report on the Drought Crisis (2016), SA's neighbours Zimbabwe, Lesotho and Botswana usually import about 1 million tons of food from SA. However, the severe drought experienced in SA caused a grain deficit and the country became a net importer of grain. About 3.8 million tons of maize were imported, about 189 707 farmers farming with livestock were affected as well as around 3.6 million livestock units (DAFF, 2016; Baudoin et al., 2017). All the countries in the region were hit hard by the decline in harvests in SA. The availability of staple foods like maize and beans declined and caused an increase in food prices, which threatened food security and massively increased costs for farming enterprises (Baudoin et al., 2017).

The 2015-2018 drought experienced in SA severely depleted the country's water reserves. Water restrictions were introduced, which especially affected smallholder farmers. The drought contributed to a decline in the country's GDP (Baudoin et al., 2017). Six provinces – KwaZulu-Natal, Free State, Mpumalanga, Limpopo, North West, and Northern Cape – were declared drought-prone regions, in contrast with the Eastern Cape (EC) and the Western Cape (WC) where only certain municipalities were declared drought-prone areas. But smallholder farmers in the EC province were severely impacted by the drought and great losses were experienced through crop failure and livestock infertility and mortality. Some farmers were overcome by mounting debt as they strived to maintain their remaining livestock. More than 150 000 herds of livestock in the EC province were destroyed by drought, with SHFs suffering the greatest losses. Owing to high levels of famine reported in the province, poor living standards, the degradation of the environment, poor household economies and limited access to useful resources, the EC is particularly vulnerable to drought (Bahta et al., 2016; Botai et al., 2018).

Even though there is documented evidence of coping and adaptation strategies among SHFs in other countries, South African SHFs continue to evince high levels of vulnerability and low coping and adaptive capacity. It will be necessary to identify possible coping and adaptation strategies to ascertain whether they are merely reactive or proactive strategies capable of reducing smallholder farmers' vulnerability while building their resilience towards drought (Jordaan et al., 2013; Belle et al., 2017).

Adopting proactive agricultural water use strategies is required because sharing and prioritising water seems unavoidable. Demand for water resources continues to increase, but these resources are limited and failing to meet the demand. Water withdrawn for irrigation will become even more scarce during drought periods, imposing a greater strain on smallholder farming (Namara et al., 2010; Phaduli, 2018).

2.5. Drought in the Western Cape

The Western Cape (WC) province is one of many South African provinces that were impacted by the 2016 drought (Western Cape Department of Agriculture (WCDoA), 2017). Global climate modelling suggests that there will continue to be significant impacts as a result of changes in climate in South Africa, and the WC province specifically. The area is subject to climate extremes such as droughts (Pasquini et al., 2013). According to various climate projections, the WC region will experience higher temperatures in the future than in the present day. Supporting these future projections, the region has experienced persistent high temperatures for the past three years and its rainfall continues to be variable. Higher temperatures in association with dryness will have various negative consequences for the economy, environmental integrity and many people's means of support (Midgley et al., 2005; WCDoA, 2017).

There is agreement among scientists that the WC province will become drier in the future. According to the Agricultural Research Council (ARC), an analysis conducted between July and September 2017 found that the rainfall was below 75% of the average in many regions.

Variable and low rainfall experienced in the province has resulted in reduced stream and river flows. This has led to a decline of more than 60% in the capacity of boreholes monitored in the WC since January 2015. Already in the WC, many cities and districts are faced with water stress. Water availability is of course essential for many economic sectors and livelihoods (DEADP, 2008; WCDoA, 2017).

According to Midgley et al. (2005), the WC region has recorded water shortages in the past because of frequent droughts. For instance, a drought that started in 1919 persisted through 1920 and beyond. The droughts experienced in the 1920s were associated with disastrous human and economic impacts. In 2003, a severe drought was again experienced in the region, raising concerns over whether the province would be capable of withstanding an extended drought of similar magnitude in the future (DEADP, 2008).

According to the Western Cape Government's Department of Agriculture (2017), the WC continues to receive below normal rainfall. The province suffered severe droughts not only in 2002-2003 but also in 2009-2010, experiencing slow depletion of water reserves. More than 500 000 Western Cape residents were exposed to meteorological drought conditions that persisted from 2008 until 2010 (Holloway et al., 2012; WCDoA, 2017). During the years 2009-11, municipalities situated in the Eden and Central Karoo Districts of the WC experienced moderate, severe and extreme drought, which had a serious impact on farmers farming with livestock because of a shortage of feed. Municipalities situated in the Overberg district also experienced severe droughts in 2010, even though this area was not eligible for drought assistance (Holloway et al., 2012).

Severe impacts were felt in the agricultural sector during the recent drought experienced in 2015-2018 in the WC province. The drought persisted for three consecutive winters. In 2017 below normal winter rainfall was experienced, coupled with warm temperatures and evaporation. This led to sharp declines in water resources and many regions were impacted across the province. The WC experienced meteorological, agricultural, hydrological and socio-economic drought in 2015-2018. The recent droughts were caused in part by a strong El Niño effect that reduces summer rainfall. The El Niño-Southern Oscillation (ENSO) is defined as a natural phenomenon that is associated with changing temperatures on the equatorial Pacific Ocean. The recent drought lasted for three winters and is the most severe on record, comparable to that experienced in 1926-1933 (Botai et al., 2017; WCDoA, 2017).

It is reported that, since the recent drought experienced in the province lasted for three consecutive winters, the dams will take three to four years to recover to the point where there is no surface water deficiency. However, if the rainfall received remains less than normal the duration of recovery will become even longer, about five years. Everyone should learn to conserve water, especially the agricultural sector as it uses most of the freshwater (WCDoA, 2017).

Various sectors were severely impacted by the drought in 2015-2018, but particularly the water and agricultural sectors. This drought had impacts on overall production, with about 25% declines in exports when comparing the 5 years running from 2008/9 to 2012/13 to the 5 years from 2013/14 to 2017/18 (AgriSA, 2019). In the southern parts of the Central Karoo and the Eden district, areas that normally receive rain throughout the year, droughts conditions are intensifying. It is reported that these areas continue to receive below-average rainfall. Also, the Overberg, Cape Winelands, and West Coast district municipalities experienced moderate drought. Insufficient rainfall accompanied by high temperatures exacerbates evapotranspiration, which causes a decline in water resources and crop stress due to compromised water availability. Dam levels were at less than 30% during the year 2015/16. In 2018 wheat production was about 1.86 million tonnes and dropped to about 1.69 million tonnes in 2019. It is therefore of great and increasing importance to identify coping and adaptation strategies that can be adopted in the province (Botai et al., 2017; AgriSA, 2019).

In the past, moderate meteorological drought, as well as agricultural and hydrological drought, has been experienced in the WC region. However, the duration of the recent drought makes it the longest (Botai et al., 2017). In comparison with the eastern parts of the WC region, severe and persistent droughts were experienced in the western areas. This will pose more risk on rain-fed fields, growing canola and wheat. Water resources decreased to less than 30% of normal capacity, suggesting that the impacts of this drought will persist for a long period. As a result, there have been discussions taking place at the level of the national government and involving private organisations, to identify different available strategies to alleviate drought in the WC and South Africa as a whole (Botai et al., 2017; AgriSA, 2019).

Regular droughts are not new in the WC region, they vary only in their severity and patterns of occurrence. Hence the recent drought is regarded as not a new phenomenon but rather a recurrent event which is part of the cycle of nature. At the same time, there are worrying signs of the possibility of drought, or at least dryer conditions, becoming permanent. All the evidence suggests that farmers in the region should learn to cope and adapt to drought conditions as an inevitable aspect of the climate in which their farming takes place (Botai et al., 2017).

2.6. Drought impacts

The impacts of drought depend on its duration and intensity. If frequency, duration, or intensity rise, reduced crop yields and livestock production are likely to occur. Declines in productivity negatively affect income and, in agriculture-based economies, can affect economic growth as a whole (Schulze, 2016; Baudoin et al., 2017).

At present, most regions across the world are experiencing water shortages. This is a fundamental problem because livestock and crop production depend on water. SHFs farming in arid and semi-arid zones are particularly affected. Smallholder farmers in these areas are likely to experience severe crop failures (Love et al., 2006; Dai, 2011).

The drought also results in high food costs, which undermine the efforts of institutions trying to reduce poverty and malnourishment. Drought can thus result in significant development setbacks (DAFF, 2016; Baudoin et al., 2017). Dry conditions in any case reduce profitability because of lower yields, and some producers experience complete crop failure. Brink (2015) notes that farmers in SA require drought relief to keep afloat.

Ngaka (2012) reports that the drought of 2007-08 caused severe livestock mortality. To reduce mortality rates, farmers transport their livestock to access feeds in areas that are less impacted by drought. However, this strategy incurs many expenses, resulting from the high cost of transportation, physical injuries and abortion due to stressful conditions. In addition, severe losses of income were experienced due to the cost of maintaining livestock, only to sell them at lower prices (Opiyo et al., 2015). Farmers struggle to access grazing and fodder due to high feed prices, which leads to severe financial pressure and cash flow problems for farmers (Brink, 2015).

Water and food security are threatened by drought, as well as the livelihoods of all water users across different climate zones. Recently, droughts have proven to be affecting even wealthy communities as a result of competition for water resources (Bachmair et al., 2016).

Drought continues to distress the agriculture sector in SA, with severe declines expected to persist in both livestock and crop production. In 2015, a reduction of about 27% was recorded for maize production over the preceding year, meaning that approximately 3.8 million loads of maize had to be imported to meet shortages. An increase in food prices exacerbated overall inflation. White maize trading prices increased to R5 000 per load and continue to distress the agriculture sector in SA, with severe declines expected to persist in both livestock and crop production (DAFF, 2016).

Water and crop deficits were experienced during the 2015-2018 drought because of below-normal rain received in the province during the planting period from October to January. As a consequence of the late onset of rainfall, many farmers were unable to plant in some regions. The government realised that this would pose a threat to food security through an increase in food prices and people losing their jobs because of a decline in production. Hence, strategies for monitoring drought impacts were implemented (Baudoin et al., 2017).

2.7. Western Cape drought impacts

The WC region has for at least a century experienced water scarcity as a result of frequent droughts. It appears that water reserves are slowly diminishing in the province. Even though employment opportunities in agriculture cannot be associated directly with climate variability, there are indirect connections in cases where working hours are disturbed, leading to job losses. The economy of the Western Cape relies upon the agriculture sector as a source of employment, and so the region has been impacted severely by job losses associated with the drought. For example, the drought experienced in 2005 significantly reduced grape yields and about 2000 permanent and seasonal jobs were threatened in the wine industry. In consequence, there was a sharp decline of more than 37 million rand in agricultural income (Araujo et al., 2016).

2.7.1. Water resources

Existing water resources in the WC are already allocated to the various areas in the province, and there seems little chance that more water resources can be developed (such as through the construction of new dams). A great deal of water is already being withdrawn from the system and water shortages are endemic. Recently water shortages were felt in the province and other parts of the country such that water restrictions had to be enforced (Parliamentary Monitoring Group [PMG], 2018). This endangers the integrity of the entire ecosystem, which relies on water. The recent situation of low dam levels as a result of low winter rainfall in the region while the demand for agricultural water continues to grow is putting more pressure on already limited water resources (Midgley et al., 2005; Botai et al., 2017; Western Cape Government, 2017). Climate projections predict that the WC will experience serious reductions in water supply and severe impacts on agriculture. For example, some areas in the Province such as Ceres and Swartbeg were faced with the exploitation of groundwater (Western Cape Government, 2011). The fact must be faced that drought in the province is a present and ever-threatening issue for farmers (Pasquini et al., 2013; Araujo et al., 2016). There is therefore an urgent need for them to devise ways to conserve agricultural water and innovate in their farming techniques (World Wildlife Fund [WWF], 2018). Adaptation is imperative since competition for freshwater will increase sharply during the warmer and drier future. It is also vital that water use is monitored to ensure that the little water that is available from water resources continues to be available in the future (WWF, 2018).

2.7.2. Food security

The impacts of drought on food security can be both direct and indirect. An impact is direct when it affects farmers which hinders the production of food, and indirect when food prices increase, food availability is reduced, and agriculture-related jobs are scarce (Midgley et al., 2005; Zwane, 2019).

Drought differs extensively from other natural hazards; it is considered an elusive phenomenon that makes mitigating and managing impacts associated with it a puzzling task. For instance, a drought-related decline in the production of food could result in a decrease in nutrition, leading to nutrition-related diseases such as malnutrition (Midgley et al., 2005). Malnutrition is an indirect drought impact because drought primarily affects the ecosystem thereby reduce food supplies which then results in malnutrition (Stanke et al., 2013). Bachmair et al. (2016) observe that drought is a disaster that occurs very slowly and it is difficult to predict its duration. Again, drought is complex because it affects various hydrological systems, ecosystems and all sectors in society. The impacts caused are usually unquantifiable as they are mostly non-structural (Mpandeli et al., 2015); because of drought and unreliable rainfall the smallholder farmers struggle to obtain high crop yields. A reduction in food production falls into this category.

During the 2015-2018 drought, great losses were experienced, including 200 000 tons of wheat, approximately 17 000 starving cattle, 230 ha of potatoes, and about 15% of the fruit harvest. This raises a question about the effectiveness of the DRR-M policy framework, regarding whether it stood up to the ‘drought test', for short-term and long-term drought relief. The provincial government applied for drought funding of about ZAR 80 million ($5.8 million) to assist farmers (Midgley & Methner, 2016). Water charges were activated as one of the ways to ensure water conservation and use efficiency by farmers (WWF, 2018).

The economy of the Western Cape nevertheless sustained heavy losses of about R5.9 billion in the agriculture sector because of 30 000 job losses and export reduction of about 13-20%. Some fruit trees and vineyards were removed due to water scarcity and to prevent the spread of pests and diseases (WWF, 2018; GreenCape, 2019). Stock farmers also experienced substantial losses, to the extent that many of them and related businesses were at risk of economic failure. Given the estimates for the increasing impact of drought on livestock farmers, it is essential that coping and adaptation strategies are documented for both crop and livestock farmers and made available at local levels (Opiyo et al., 2015).

There is now a question over whether the available strategies in the province are capable of withstanding severe future droughts (Botai et al., 2017). Kiem and Austin (2013) point out that, drought adaptation strategies must be strong enough to cope with uncertainty if they are to be successful.

2.8. Government strategies to manage droughts

A number of drought response programmes were undertaken in Southern Africa (including South Africa) right after the droughts experienced in the 1980s and 1990s, but these have been described as reactive rather than proactive, emergency support programmes (Dube, 2008; Bahta et al., 2016).

South Africa is among the countries that have planned for drought occurrence. In the past, drought management in SA focused mainly on commercial farmers and responded slowly and ineffectively to drought impacts on smallholder farmers. Over time, the policy shifted to include SHFs (Dube, 2008). The disaster management policy in SA includes proactive strategies that allow for prior planning before the drought occurs, but do not state which options will be made available during the course of drought and who to communicate with (Mitchell & Mcdonald, 2015). There policies and strategies aligned to training and supporting. The White Paper on Agriculture was established in 1995 and served as a guiding document in agriculture, intending to support resource-poor farmers financially (Department of Agriculture, 1995). In the year 2001, the Agricultural Sector Strategy Plan for the Department of Agriculture was developed as a response tool to help smallholder farmers overcome the constraints they face in their farming (Department of Agriculture, 2001). Departing from the Strategic Plan for the Department of the Department of Agriculture in 2004, a government-funded grant called a Comprehensive Agricultural Support Programme (CASP) came into effect. The CASP is one of the Department of Agriculture; Forestry and Fisheries (DAFF) programmes together with Ilima/Letsema programme that focuses mainly on household food production (Xaba and Dlamini, 2015; African Centre for Biodiversity, 2018). The CASP grant aimed at helping smallholder farmers by providing all necessary training and financial support, advisory assistance, information and knowledge as well as farm-related infrastructure to increase smallholder farmers' production and reduce their poverty levels (Xaba and Dlamini, 2015). Agricultural Policy and the Strategic Plan for South African Agriculture are the consistent policy documents with objectives aimed at reducing inequality among smallholder farmers and increasing their agricultural production. Therefore, the CASP goals are aligned with the Agricultural Policy and the Strategic Plan for Agriculture (Xaba and Dlamini, 2015; African Centre for Biodiversity, 2018). Midgley and Methner (2016) agree that there are in existence-integrated policies covering the spectrum from short-term relief to long-term resilience building and adaptation. However, they argue that currently these policies are not effectively interpreted and implemented at different levels of government. This implies that the plan is reactive rather than proactive since it does not defend against future drought.

Past drought studies conducted in SA have noted the tendency to concentrate mainly on drought relief and emergency support to livestock farmers residing in regions declared as disaster drought areas, with little if any provision to assist crop farmers. There are also indications that even in the recent drought, the support provided has been reactionary. This suggests that strategies recommended in terms of the Disaster Management Act (DMA) (2002) were only implemented after the impacts of the recent drought had been felt (Schwabe et al., 2013; Baudoin et al., 2017).

Water supply strategies were developed by the government to cope with water shortages during the course of drought. These included drought relief and backup relief, rainfall storage improvement as well as water tanking (Mukheibir, 2008).

Unfortunately, these failed and water management strategies were then introduced. Changes are continuously made within the community to ensure that there is sufficient water to meet demand. The Disaster Management Amendment Act, No. 16 of 2015, is something of a milestone in integrating climate change adaptation with disaster relief (Midgley & Methner, 2016). The regulations under the Act give people early warning so that they can prepare and put in place strategies to prevent or mitigate the harshest impacts of drought. These strategies are seen as continuous duties for all parties involved in agricultural-related activities. However, no additional funding is made available to offer training towards implementing these strategies, such as training to strengthen farmers' resilience towards drought through the DMA. An existing provincial and municipal budget is supposed to cover the implementation of these strategies, but cannot. Farmers are forced to utilise their resources to plan for the occurrence of climatic events since there is no budget allocated for this (Baudoin et al., 2017). In 2007/08 government of South Africa spent a sum of R285 million for drought schemes. A sum of R20 million for funding and R20 million for risk management was allocated for smallholders in the Eastern Cape. In the Free State province, smallholder farmers were allocated funding of R25 million and for risk management a sum of R25 million was allocated for smallholder farmers (Challinor et al., 2007).

The findings of a study conducted by Ngaka (2012) reveal that the implementation of the drought support system has helped farmers to access feeds at lower prices. Around 35% of farmers mentioned that as a result of the scheme their income had increased. Some farmers mentioned that the scheme improved the calving rate. However, Ngaka (2012) showed that the relief was only capable of addressing farmers' immediate needs and had little impact on building resilience to withstand future droughts. Schwabe et al. (2013) concurred that drought relief had failed to achieve a notable reduction in the vulnerability of farmers or to bring about improvement in their resilience towards drought. The implication was that in the future farmers will continue to depend on the government to respond to droughts, leading to unsustainable farming practices. This is attested to by one farmer who was quoted as saying that "although I like freebies, the government should teach us how to fish instead of fishing for us". To overcome this trend, policies should be aimed at improving and supporting farmers' resilience in the face of droughts, while encouraging them to use natural resources in a sustainable manner (Ngaka, 2012).

In the recent drought, the government spent more than R1 billion for drought management, in addition a sum of R528 million was allocated specifically for smallholder farmers. The Industrial Development Corporation [IDC] allocated R500 million for loans for SHFs, and the Department of Water and Sanitation [DWS] committed R502 million for drilling boreholes, delivering water and securing springs. Agri-parks programmes supported about 16 447-smallholder farmers in 2015. Through the support, about 16 000 ha of lands were cultivated (DAFF, 2016).

Even such disaster assistance as the government offers has proven to be untimely and unsuccessful because it is poorly coordinated (Ngaka, 2012). Jordaan (2017) claims that drought relief does not, in any case, provide insight into peoples' vulnerability nor reduce risk or improve resiliency against drought. Moreover, Ngaka (2012) claims that despite the significant investments by the government towards drought recovery strategies, questions keep arising about the government's failure to provide proactive support that will improve farmers' stability and ability to withstand future droughts, thereby ensuring sustainability (Ngaka, 2012). Furthermore, there has been insufficient support from the national government for smallholder farmers due to the absence of the necessary drought disaster declaration and adequate funding (Midgley & Methner, 2016).

Baudoin et al. (2017) point out that at municipal, provincial and national levels, the distribution of drought relief is the main response to the climatic disaster. Smallholder farmers themselves do not have the funds and capacity to plan for droughts and other climatic events, and not enough government funding is made available for investing in proactive strategies (Baudoin et al., 2017).

Bahta et al. (2016) argue that, even though the South African government to minimise drought impacts adopted the drought relief system, the relief concerned is typically too late and insufficient. Also, the drought relief scheme is said to focus on addressing immediate impacts and needs for smallholder farmers, while failing to prepare farmers for future droughts. According to the Department of Agriculture, Forestry and Fisheries [DAFF] (2016), the country needs to readjust its planning to help the sector prepare for future droughts as well as cope during and after drought occurrence (DAFF, 2016). The strategies adopted by smallholder farmers should be strategies to increase their resilience and reduce their vulnerability to droughts.

Identifying and describing agricultural water use coping and adaptation practices in respect to recurrent drought is very urgent and necessary for the country to minimise drought impacts and build SHFs resilience. An assessment conducted for the allocation of drought relief for the 2007/2008 drought revealed that the relief focused only on coping with immediate impacts and did not reduce vulnerability (Ngaka, 2012). Midgley et al. (2005) stress that the benefits of developing strategies for adapting to water shortages are much greater than the expenses associated therewith. Jordaan (2017) says that the 2015-2018 drought created awareness of the critical effects of a prolonged drought and the danger of not maintaining water infrastructure in good order. If South Africa does not plan properly for the next drought, the agriculture sector will again be the most heavily impacted.

2.9. Drought coping and adaptation

Various studies have been conducted on how to adapt to climate variability, which includes but not limited to droughts, and of what specific strategies can be adopted to lessen the damage caused by these climatic events. More recently, research has been conducted in the agricultural sector, focusing mainly on strategies adopted by farmers to reduce impacts of drought in farming and on livelihoods (Midgley et al., 2005; Ayanlade et al., 2018).

From the literature, it is quite evident that in the past disaster strategies were only implemented globally as well as in Africa after the effects of drought were manifested and felt. Despite the progress made in trying to cope and adapt to drought, many countries in Africa continue to rely on crisis management strategies. These strategies have therefore been termed reactive strategies, with their success measured by the number of people who benefit from drought relief or support rather than by how much the intervention has addressed vulnerability and strengthened resilience towards drought (Baudoin et al., 2017; Tadesse, 2018).

2.10. Strategies adopted by farmers to deal with drought

In past years, climate variability did not feature prominently as a significant threat to water resources. As a result, no drought adaptation strategies were established to lessen predictable impacts. Nevertheless, over the years strategies and policies were developed for water management to make certain that the supply of water would continue to meet growing demand. Some of the strategies were thought to have the potential to deal with future water shortages, responding to the need for robust adaptation plans to make certain that the supply of water does not fall short of demand, even when availability is compromised (Midgley et al., 2005).

Over time, farmers in Southern Africa (including South Africa) have through repeated experience devised ways of coping with drought and minimising drought impacts. These ways of coping are seen as effective plans to help minimise the effects of drought in the community, and thus minimise food shortages (Mukheibir, 2007; Mascndeke & Shoko, 2014).

Responding to mounting drought impacts, changes were made in agricultural practices by vulnerable individuals, including varying types of crops, altering dates for planting, and changing row spacing and planting density. Strategies like tillage management, furrowing, terracing, protecting fields from water loss and wind erosion, which all help to retain moisture through evaporation reduction and increases infiltration, are seen as effective ways of dealing with drought. Rainwater harvesting from roofs was another effective way of increasing the water supply for irrigation (Mukheibir, 2007; Zwane, 2019).

Farmers adopted other measures to reduce losses, including buying feeds to maintain their herds and selling some livestock. Transporting livestock to camps with grazing, and buying medicine and supplements for depleted livestock were other coping strategies adopted by farmers. It was important to make farmers aware of the coming drought and encouraging them, especially black farmers, to take part and adopt these disaster reduction strategies (Ngaka, 2012).

2.10.1. Coping strategies for livestock production

Coping strategies are seen as short-term responses to drought, whereas adaptation responses help farmers to adapt to drought over a longer period (Mukheibir, 2007). Agricultural water use strategies must be put in place so that the effects of drought on livestock and crop production can be mitigated. The literature shows that in terms of pasture management, there are several strategies to conserve water in pastures such as through the construction of spreader sets on grazing camps, managing grazing, and adopting ecological principles and reducing the number of livestock to reach a level of feeding demand commensurate with available grazing (Jordaan, 2011; Ncube, 2017; Ncube, 2018). In the study conducted by Hornby et al. (2016) in Limpopo, water was being carried from the source to the livestock on the farm during the drought. Mukheibir (2007) argues that fetching water from the river is a reactive strategy; and Midgley et al. (2005) believe that when water is drawn from rivers and wells, it is likely that the water supply will be impacted directly by the drought. Smallholder farmers moved their livestock to secure areas with natural grazing and water during drought periods (Chitongo & Casadevall, 2019; Ndlovu, 2019). There is a need to identify and describe proactive strategies that livestock farmers can adopt to cope with drought.

2.10.2. Coping strategies for crops

To cope with drought, crop farmers employ zero or minimum tillage to conserve moisture in the soil, a method that requires less water and is good for early planting (Ncube, 2017). Smallholders make use of different crops and change the dates of planting and irrigation (Falco & Veronesi, 2014). For example, farmers can use flood irrigation to water at night to reduce levels of evaporation and allow water to infiltrate the soil and restore the water table (Center for Urban Education about Sustainable Agriculture [CUESA], 2014). Smallholder farmers also benefit from rainwater harvesting and planting crops that are suited to the soil and the region (Vilakazi, 2017). Mulch is also used as a soil covering (Ncube and Lagardien, 2015, Ncube, 2017, Ncube 2018). It helps farms during dry periods to preserve more water in the soil while increasing the ability of the soil to preserve water (CUESA, 2014).

2.10.3. Livestock adaptation strategies

Livestock farmers' adaptation strategies include transporting livestock to places with pasturage, feed, and water and have worked effectively to offset the effects of drought (Opiyo et al., 2015). Livestock diversification and preferably farming with goats is also seen as proactive as goats are reported to be capable of withstanding drought better than sheep. Goats do not require much water they get most of their water from their feed. Sheep, however, do require more water when the temperature rises (O'Farrella et al., 2009; Berhe et al., 2017). In the study conducted by Opiyo et al. (2015), it was found that farmers preferred to raise camels and goats because they are perceived to be more resistant to drought periods than sheep and cattle. The use of emergency fodder in drought times is yet another adaptation strategy adopted by livestock farmers (Speranza et al., 2010).

According to Ncube (2017) and Ncube, 2018, boreholes are frequently considered appropriate for mitigating extreme droughts. During the recent drought in SA, the Department of Agriculture, Forestry and Fisheries drilled many boreholes for livestock farmers in the KwaZulu-Natal, Mpumalanga and North-West provinces (Ncube, 2017). Many farmers rely on municipal water or wells (groundwater), which can become problematic due to high water prices. Others have constructed dams to capture and store rainwater during rainy periods (CUESA, 2014).

2.10.4. Adaptation strategies for crop production

Farmers to build their resilience towards droughts caused by climate variability have adopted various adaptation strategies. In Limpopo, for instance, many farmers planted crops that mature early, and crops that require less irrigation water such as groundnuts and sorghum. Some smallholders adopted conservation agriculture, such as minimum tillage and zero tillage (Mpandeli et al., 2015). Livestock smallholder farmers in some of the areas in the district were also using the destocking especially during uncertainty periods (Mpandeli et al., 2015). In Ghana, for instance, many farmers change planting dates and plant crops either that are more resistant to drought or mature earlier. They also use different irrigation techniques and construct water harvesting systems to adapt to drought (Antwi-Agyei et al., 2014). The practice of zero tilling, mulching and fallowing in drought times were among the most widely adopted adaptation strategies (Speranza et al., 2010). In Tanzania, SHFs employ adaptation strategies that include using water from the river for irrigation purposes and planting crops that are resistant to drought and/or mature early (Komba & Muchapondwa, 2018).

For crop production, the most prominent adaptation strategies during drought periods are therefore changing crop varieties, crop rotation, shifting planting dates, practising soil and water conservation tillage activities, using improved agricultural inputs, and irrigation (O'Farrella et al., 2009; Ringler et al., 2011; Komba & Muchapondwa, 2012; Falco & Veronesi, 2014; Bocher 2016; Adusumilli & Wang, 2018). Farmers that lack the capital to implement other strategies at the very least change planting dates (Komba & Muchapondwa, 2012). While access to credit is said to increase the likelihood of farmers' adopting other strategies other than changing planting dates (Belay et al., 2017), practising water conservation and irrigation techniques are also adaptation strategies that have been implemented at farm level in response to drought (Uddin et al., 2014).

2.11. Factors limiting adaptation

Despite the range of strategies to choose from, smallholder farmers are hindered by several factors in adopting adaptation strategies (Tambo, 2016; Elum et al., 2017). These include poverty, lack of sufficient resources, and a lack of awareness or knowledge, all of which limit adaptive capacity. It is important to understand the factors and address them properly to help farmers implement recommended strategies (Speranza et al., 2010; Tambo, 2016).

In a study conducted by McLeman et al. (2008), farmers did not adopt any coping and adaptation strategies in the face of severe droughts, due to under-capitalisation, the size of their land, insecure land tenure and lack of financial support and to invest in coping and adaptation strategies (Harvey et al., 2018). Below (2015) argues that factors hindering adaptation include limited livelihood resources, severe social effects, and the consequences of farming procedures.

Recently, the South African government has put in place different plans to minimise SHFs' exposure to drought impacts. The plans went through different stages from an impact relief scheme to risk reduction and, lastly, drought management strategies. Nevertheless, all these efforts failed due to poor coordination and a lack of capacity or will on the part of the government (Austin, 2008). Strategies that might be adopted by farmers in response to drought are associated with challenges that impede farmers from implementing them (Baudoin et al., 2017; Botai et al., 2017). Key factors that hinder smallholder farmers from implementing appropriate drought adaptation strategies include short-term lease agreements employed in some regions, which are said to discourage farmers from investing more in their farms (Love et al., 2006). Other hindrances include limited financial assets to cover the capital and costs of implementation. Similar factors deter the agricultural sector from conserving water and managing water. In some regions, the sector seems not to acknowledge predicted climate variability and its associated impacts (Mukheibir, 2008).

Findings from the study conducted by Rakgase and Norris (2014) suggest that water resource availability and land lease agreements influence SHFs' capacity to adapt to droughts. The study also disclosed that farming experience, land size, and income received affect coping strategies; while farmers' age, level of education and the extent of the impacts had no effect.

Also, a study conducted by Kom et al. (2020) in the Vhembe district, in Limpopo province, age had no significant impact on the choice of coping and adaptation adopted by smallholder farmers to respond to climate change. According to Opiyo et al. (2015), respondents in their study reported a lack of capital and low income, lack of land security, lack of access to affordable credit organisations, lack of formal knowledge and illiteracy, poor markets and limited infrastructure for undertaking agricultural activities.

This study seeks to identify and explore the critical factors that limit smallholder farmers from adopting strategies to cope and adapt to drought in the Overberg and West Coast District, and to make recommendations as to how these factors can be addressed for the benefit of farmers. Khapayi et al. (2016) claim that having a clear understanding of significant factors that hinder smallholder farmers' development is important to establish proactive and effective policies and develop proactive strategies and models to support and enhance smallholder farmers' livelihoods.

According to Rakgase and Norris (2014), creating an understanding of these factors will help enable relevant institutions to establish programmes and policies aimed at supporting smallholder farmers and showing them how their drought coping strategies could be improved, thereby preserving their livelihoods. Khapayi et al. (2016) claim that SA cannot risk putting in place reactive programmes and policies to support farmers that do not work. The aim must be to identify and address the challenges with which smallholder farmers cannot deal on their own. The goal is to enable smallholder farmers to cope, plan for future droughts and learn to adapt, which will then decrease their vulnerability.

2.12. Need to cope and adapt to the drought

According to Love et al. (2006), there is a complex interrelationship between people and drought that has implications for how to minimise the damage caused by drought and choose appropriate strategies to reduce future vulnerability. Mukheibir (2008) argues that it is because in the past changes in climate were not recognised as a significant threat that there were no measures put in place to adapt to predicted impacts. Smallholder farmers rely mainly on rainfed agriculture and they suffer from food insecurity because of recurrent droughts (Love et al., 2006; Mabhaudhi et al., 2018). Studies indicate that drought reduces food production which results in hunger for many regions and will result in further severe food shortages in the future (Kogan et al., 2019). In many regions, drought is the natural disaster and should be regarded as an inevitable aspect of the climate, which makes it crucial that drought coping and adaptation strategies are developed (Wilhite et al., 2005; Rey et al., 2017)

People acknowledge droughts in the agricultural sector and they are aware of future dry conditions. People are just waiting for the next drought and wondering how severe it will be.

The real challenge is how to prevent disastrously dry conditions resulting from drought, by strengthening coping and adaptive capacity and decreasing vulnerability (Bahta et al., 2016). Each drought strategy developed in agriculture should be capable of reducing vulnerability and increasing resilience (Jordaan et al., 2013), in preparation for future droughts in southern Africa (Bahta et al., 2016).

Semi-arid regions are faced with severe water scarcities these regions are therefore forced to manage water more efficiently, as water shortages will become even severe more in the future as a result of recurrent droughts. Climate variability is the main factor exacerbating water scarcity, together with rising temperatures that are increasing evaporation rates (Msira, 2014; Abedin et al., 2019).

Currently, water is increasingly becoming a priority issue, the policies and techniques that are being implemented are intended to ensure that water supply is not compromised and will continue to meet rising demand despite the current climate variability (Mukheibir, 2007; Cosgrove & Loucks, 2015). However, it is not guaranteed that the water supply system in the WC will be able to withstand the recurrent droughts in the province and continue to meet the increasing water demand. The province strives to improve resilience in the face of climate variability and water scarcity in all sectors of the economy, by finding strategies to conserve water and monitor increasing demand (DEADP, 2008; Harris et al., 2018).

By implementing adaptation options, vulnerability, which measures the degree of susceptibility to an adverse effect of climate variability, can be reduced. Reducing vulnerability through adaptation strategies leads to building resilience (Chaudhury, 2017; Dapilah et al., 2020). This is also emphasised by target 13.1 under goal 13 of Sustainable Development Goal (SDG), which stresses the need for all countries to improve adaptive capacity and strengthen resilience towards natural hazards (Chaudhury, 2017). This will help minimise the effects of drought on smallholder farmers' livelihoods (Global Water Partnership Eastern Africa (GWPEA), 2016).

2.12.1. Building resilience

Strengthening the adaptive capacity of society is critical to achieving sustainable development amid climatic events (Osbahr, 2008; El-Ashry, 2009). Recently, building resilience towards environmental disasters and all climate-related disasters has become a common idea, inviting extensive research. Enhancing resilience will increase the capacity to plan for future disasters and reduce vulnerability in the face of them (Mavhura, 2015). If countries or regions fail to adapt, they will face severe threats to water and food security and agricultural production (El-Ashry, 2009). As noted above, smallholder farmers participate dominantly in rain-fed agriculture and depend only on natural resources. This is typically exacerbated by meagre adaptive capacities, so strengthening resilience offers the obvious path to minimising their vulnerability (El-Ashry, 2009; Speranza, 2013).

Goal one of the Sustainable Development Goals (SGDs) is to "end poverty in all its forms everywhere." Then under target 1.5, it is declared that by 2030 the world must "build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social, and environmental shocks and disasters." Goal 13 of the SDGs focuses purely on climate change, demanding "urgent action to combat climate change and its impacts." To achieve this goal (target 13.1 we must "strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries" (Chaudhury, 2017).

2.12.2. Improve Livelihoods

Many developing countries are experiencing high rainfall variability, yet lack strategies to cope with this and plan for future variability. Droughts have major impacts on these countries, not only in terms of human loss but also in long-term development (Ludwig et al., 2007). Africa has the highest mortality-related vulnerability indicators for droughts. Farmers must learn to adapt to drought conditions since their livelihoods are impacted by different climatic disasters. Agricultural production declines and employment is lost, and both lead straight to rural impoverishment (DEADP, 2008; United Nations International Strategy for Disaster Reduction [UNISDR], 2015). Farmers naturally optimise their management practices based on their years of farming experience. But the impact of changing climatic conditions is rather like shifting the goalposts and calls for robust adaptation strategies that will keep up with current and future climate risks to improve farmers' livelihoods (Meybeck et al., 2012).

According to Austin (2008), the absence of effective drought management strategies exacerbates severe impacts and the vulnerability of farmers to drought. Delaporte and Maurel (2015) insist that learning to cope with drought and adapting in the long term can help smallholder farmers to stand alone and reduce their dependence.

2.12.3. Food security

There is a direct and indirect link between climate variability, agriculture and the production of food. Impacts are said to be direct when there are changes in agro-ecological conditions and indirect when they affect farmers' income. Over ten years ago, it was predicted that rain-fed production in Africa would decrease by 50% by 2020 (El-Ashry, 2009; Saina et al., 2013). Climate risks pose considerable challenges to food security and severe impacts on the livelihoods of many individuals are expected in the future. The association between climatic events and food security is very complex and encompasses many elements such as food production and the process of manufacturing, trade, diet and how people manage to access food during droughts and other climatic events. The consequences can include high prices, million people at risk of hunger and even malnutrition (Ziervogel & Ericksen, 2010; Masipa, 2017).

There has been noticeable development towards achieving the reduction of extreme poverty, one of the MDGs. For example, between 1990 and 2015 there has been a decrease in the number of people surviving on less than a dollar a day from 1.9 billion to 836 million (United Nations, 2015). Similarly, the percentage of people suffering from malnutrition in developing areas has decreased from 23% in 1990-92 to 13% in 2014-2016. Combating poverty and famine remains the priority for SDGs. The agenda of SDGs applies to all countries and goes further than MDGs, focusing on sustainable development policies (Kumar et al., 2016; Chaudhury, 2017).

Agriculture is highly sensitive to climate change and this will mean persistent threats to food security in the future. Given the increasing demand for food, the sustainable production of food is essential. Employing adaptation strategies can help to achieve SDGs One and Two, which are to “end poverty in all its forms everywhere” and to “end hunger, achieve food security and improved nutrition and promote sustainable agriculture.” Sectors involved in food production must find ways of adapting to and building resilience towards recurrent droughts to help reduce poverty and protect people's livelihoods (Ziervogel & Ericksen, 2010; Vermeulen et al., 2012; Chitongo & Casadevall, 2019).

CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

This chapter describes the research design, research approach, study site and research methodology used in the study. Justification is provided for the choice of research approach, data collection methods and procedures, and the mode of data analysis.

3.2. Research design

According to Agee (2009), a research design is a strategy proposed to provide a proper framework to complete the study. It includes all planning and all the steps to be taken by the researcher to make sure that all research questions are addressed efficiently and effectively (Sileyew, 2019). A research design reflects the complete approach of the research process from the theoretical basis to the gathering and analysis of the information (Conrad et al., 2014). The research questions and actions taken by the researcher in response to the questions determine what type of design to be used (Agee, 2009).

The research design allows the researcher to gather accurate and usable information within a proper method of research. An effective research design indicates the logical relation between the research questions and the techniques proposed to generate data to answer them (Denzin & Lincoln, 2000; McMillan & Schumacher, 2001).

The study adopted a participatory study approach. In the participatory approach, participants are the centre of the research. This approach uses qualitative methods such as interviews and focus group discussions to gain understanding and insight into the lifeworld of the research participants (Mouton, 2001).

According to Schurink (1998), qualitative research enables an understanding of the subjects' experience, ideas and decision making. In this instance, the understanding enabled is of smallholder farmers' perceptions of drought, of how they have managed to cope thus far, and how are they adapting to deal with future droughts. Babbie and Mouton (2001) add that adopting a qualitative research style helps the researcher to develop an insider view, analysing the everyday life of the respondents.

To capture the reality on the ground, as it were, of the 2015-2018 drought, it is essential to explore the phenomenon from the smallholder farmers' point of view, and this was done through qualitative research using a participatory approach.

3.3. Research setting

3.3.1. Background

The WC province covers about 129 370 km^2 of the South Africa and is located in the south-western part of the country. The Indian Ocean borders the south parts and, in the west, it is bordered by the Atlantic Ocean, while the eastern and northern areas are bounded by other provinces in the country. There are three different climatic areas in the province, the Mediterranean, South Coast, and the Karoo regions (Du Plessis & Schloms, 2017). The Mediterranean area is located in the western and south-western parts of the province, and rainfall is mostly received during winter time (May to August), and experiences moderately dry summers. In contrast, the South Coast area receive rain all the year. The Karoo region only receives most of its rainfall in the form of thunderstorms during late summer. Temperatures vary significantly between winter and summer in these regions, while experiencing low variable rainfall (Midgley et al., 2005; Van Niekerk & Joubert, 2011; Botai et al., 2017).

In the WC region, agriculture has economic, historical, political, and cultural importance. There are two dominant enterprises in the region, fruit and wine production. Farmers involved in smallholder agriculture are competing with commercial farmers for all necessary resource such as water and land and they also struggle to develop sustainable livelihoods since they lack access to finance and markets (Debbané, 2007).

Midgley et al. (2005) show that the WC province has a history of water scarcity and recurrent drought conditions. Ncube and Lagardien (2015), and Ncube (2018) note that the WC is already facing water stress and this pressure will intensify as the need for growth and development increases. Climate projections propose the probability of more recurrent and extreme weather such as droughts (WCDoA, 2017).

The recent drought in the province lasted for 3 consecutive winters and was declared historically severe. Several municipalities declared local disasters under the Disaster Management Act. A provincial drought disaster declaration was made in May 2017. The West Coast and western parts of the Overberg regions were extremely dry; grasslands and the stubble lands had very little fodder available for the livestock (Western Cape Department of Agriculture [WCDoA], 2017; WCDoA, 2018).

3.3.2. Study sites

This study was conducted in the Overberg and West Coast District Municipalities in the Western Cape province of South Africa (Western Cape Department of Agriculture, 2017). Figure 1 shows the location of the study districts within the Western Cape.

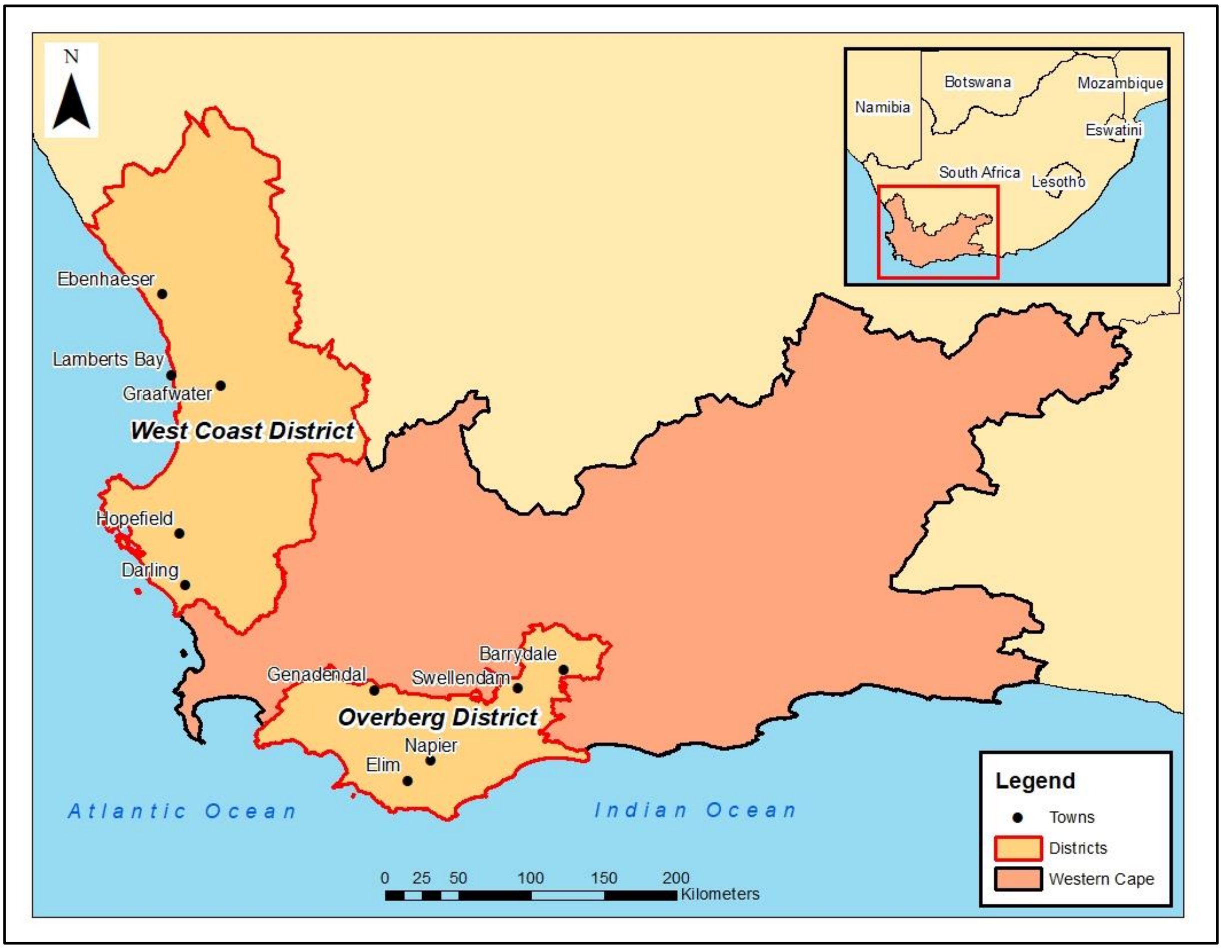

Figure 1: Map showing Overberg and West Coast Districts, Western Cape

The West Coast District (WCD) is a rural district that comprises 5 local municipalities with the second-lowest population density after the Central Karoo (WCD, 2018). The population in 2018 was 433 445 with 129 862 households, and the estimated population in 2019 was 439 036. The region covers 31 119 km^2 of the province. There are seven towns: Clanwilliam, Darling, Ebenhaezer, Graafwater, Lamberts Bay, Malmesbury, and Vredendal. WCD has limited arable land because the soil is mostly sandy with poor nutrients. In 2013, unemployment was 15% and in 2016 decreased to 12%, but because of the drought in 2017 increased again. The sector of agriculture, forestry and fishing are three large sectors in the region that contribute to the province's GDP. In 2011, these sectors contributed 15% and in 2016, they contributed 19% (WCGPT, 2014; West Coast District Municipality [WCDM], 2017; WCDM, 2018). On arable lands, farmers grow mainly wheat. Alien plants have invaded some areas in the district. Water resources in the region are threatened by high temperatures and decreasing rainfall (WCDoA, 2016; WCDM, 2017).

Livestock and crop production remain the main livelihood for many people in the area. Drought and water scarcity remain the main challenge faced in the region, followed by widespread dependency on social grants. The latter reflects the rapid rise in levels of poverty between the years 2011 and 2015 (WCDM, 2017; WCDM, 2018).

The Overberg District (OD) is located to the east of Cape Town beyond the Hottentots-Holland Mountains. The region is the smallest making up only 9% of its geographical area, about 12 239km² and comprises four local municipalities. The seven towns covered in the region are Barrydale, Bredasdorp, Elim, Genadendal, Napier, Suurbraak and Swellendam. The population in 2018 was 284 272 and the estimated population in 2019 is 287 752 (Western Cape Government Provincial Treasury [WCGPT], 2014; WCDM, 2017).

Dryland farming takes place in the southern parts of the district and is mostly given over to wheat farming, but livestock production takes place across the district. The other food produced on a large scale is fruit (Overberg District Municipality [ODM], 2017). Crops that require irrigation include vineyards, orchards, lucerne, and some cash crops. These are all fed by water from mountain streams and the Breede River, as well as groundwater. There are a few dams in the Overberg and people depend mainly on groundwater (River Health Programme [RHP], 2011). Large land use is mainly by agriculture and is the main contributor to the economy of the region. Mediterranean climate is dominant in most areas in the region, with dry and warmer summers and regular wet, cold winters. Drought conditions are probably going to increase because of inconsistency in rainfall and changes in the climate (ODM, 2017).

During the recent drought, both these districts were extremely dry and reported a scarcity of fodder for livestock (WCDoA, 2018). The West Coast District was chosen as a suitable study site because it included affected municipalities declared local disasters for agricultural drought in the year 2015 (Provincial Disaster Management Centre [PDMC], 2017). According to the West Coast District Municipality Annual Report (2015/16), the year 2015 was the driest year since 1921 on the West Coast. There were extreme declines in production and rainfall between October and December 2015 (Provincial Disaster Management Centre, 2017; West Coast District Municipality [WCDM], 2017). Various farmers had to request help from the Western Cape Department of Agriculture (WCDoA) as a result of the lack of winter rainfall (WCDM, 2017).

There is a likelihood of extreme drought conditions in the future in association with warm temperatures, which can worsen evapotranspiration, leading to declines of water in different water resources and causing crop stress. This calls for urgent strategies to help smallholder farmers to prepare for and survive drought periods (Botai et al., 2017; WCDM, 2017).

The agriculture sector experienced negative growth in 2015 and 2016 compared to 2014 (WCDoA, 2017). The Integrated Development Plan (IDP) reveals that the nature of rainfall is changing, with increasingly more days of high-intensity rainfall, but fewer days of rain overall.

This is another pattern that needs to be addressed with appropriate coping and adaptation strategies (WCDM, 2017).

The Overberg District (OD) was chosen as a comparison site; according to the Department of Local Government (2017), Overberg is among the regions that were affected by drought but not declared a disaster area. According to Western Cape Department of Environmental Affairs and Development Planning [WCDPEADP] and ODM (2017), even though no major droughts have been experienced in the Overberg in the last decade, the municipality was in the same situation as most of the WC, with water demand increasing and threatening to surpass supply. According to the Overberg Water Board (2017), the Overberg region experienced particularly harsh drought impacts even though it was not declared a disaster area. A request was made for the region to indeed be declared a disaster area because of the magnitude and severity of the effects of the drought (Overberg Water Board, 2017). However, the district had not yet been declared a disaster area during the time of the interviews. The demand for proactive strategies that will build farmers' resilience towards droughts has substantially increased (Robinson, 2017; GreenCape, 2018).

According to climate projections, the Overberg district is expected to experience declines in rainfall and extreme recurrent droughts. Drought and declines in water supply pose great threats in the region. The decrease in rainfall will cause an increased risk of water scarcity and drought throughout the district. Economic growth in the region has been on the decrease in recent years, which can be accredited to the reductions in the sector of agriculture due to the drought conditions (Western Cape Government, 2017). The municipality should, therefore, continue to plan for historical climate-related impacts whilst being mindful that these impacts will become more severe over time (Robinson, 2017). There is an urgent need for strategies and skills to assist farmers with improving their resilience towards water scarcity (GreenCape, 2018). In the Water Research Commission Report TT 716/1/17, it is emphasised that we need to find ways to reduce vulnerability in the local agricultural sector by introducing timely and relevant adaptation measures, as well as building resilience in the system. Drought remains an ever-present threat to the local agricultural sector and is likely to increase in some areas over the next decades (Jordaan, 2017).

3.4. Sampling method

The purposive sampling method was employed to select study participants. According to Babbie and Mouton (2001), a qualitative study sampling method is often purposive. Purposive sampling allows participants to be deliberately selected on the grounds of predetermined characteristics. Patton (2002) notes that purposeful sampling is a technique generally employed in qualitative research to identify and choose knowledgeable participants, to effectively make use of limited resources. Creswell and Clark (2011) agree that purposive sampling assists with identifying and selecting individuals or groups of people who are knowledgeable concerning the phenomenon of interest. In summary, a purposive sample is a non-probability sample chosen based on populations' shared characteristics and study objectives. The method is also called a judgmental or subjective sampling and it is useful to help a researcher with reaching a targeted sample faster (Crossman, 2018).

Purposive sampling comprises seven types, each suitable for a different objective. For this study, a homogeneous purposive sample was selected, that is, a sample with common qualities or set of characteristics (Palinkas et al., 2015; Crossman, 2018). For this study, the shared characteristic sought was the experience of farming as a smallholder farmer, and farming on dry land. It was believed that the participants chosen would be able to provide the researcher with information regarding their current knowledge about drought and their previous drought experiences. This would include information on how farmers managed to cope with the 2015-2018 drought and how they were planning to adapt to future droughts.

The sample size for the study is 100 smallholder farmers practising crop and livestock production. According to Niles (2006), each study needs to have a large number of participants to have certainty that study results are representative. The author says that, if the size is increased to 100 participants, your margin of error falls to 10%. For example, if rainwater harvesting was reported by 60% of participants as the main strategy to adapt to drought, there would be a 95% likelihood that between 50% and 70% of overall population practise rainwater harvesting (Niles, 2006).

The sample comprised 50 smallholder farmers from OD and 50 smallholder farmers from WCD. The study selected smallholder farmers as appropriate participants in the research because for many years' smallholder farmers have had to struggle with agricultural-related challenges and drought, mostly without the help of the Government. As a result, many smallholder farmers have not been able to adjust to changes in markets and policy and have had to leave farming (Austin, 2008). According to Midgley and Methner (2016), the continuous drought in the WC province has particularly affected smallholder farmers who lack the resources to deal with it. The drought has led to an increase in bankruptcy cases among black smallholder farmers and forced many of their newly reallocated farmlands (Latham, 2016). The author also mentions that in Makhaza, in the WC province, one farmer argued that their efforts on the land were not being recognised or reaping a reward because of water scarcity. Jordaan (2011) adds that in comparison with commercial farmers, smallholder farmers are more exposed to drought, with insufficient farming resources and proper strategies to cope and adapt to drought without getting support from other people.

3.5. Data collection

To achieve the objectives of the study by capturing farmers' experiences of the recent 2015-2018 drought, a semi-structured questionnaire was employed for face-to-face interviews. The aim was to gather data on farmers' characteristics, land, and water resources, as well as drought information and agricultural water strategies, implemented by farmers during drought periods. Face-to-face interviews were chosen over other types of interviews because they allow in-depth engagement interviewer and the respondent (Trochim, 2006). To validate the data obtained from the interviews and to widen the scope of information gleaned, focus group discussions were conducted. All the interviews with individuals and focus group discussions were audiotaped with the permission of the participant, and additional notes were taken during the interviews to make certain that all relevant data was captured.

3.5.1. Data collection for Objective 1

To conduct a literature review of coping and adaptation strategies for agricultural water use adopted by smallholder farmers (with an emphasis on South Africa).

A desktop study was conducted to identify the agricultural water use coping and adaptation strategies adopted by smallholder farmers in South Africa and a few selected countries. The reason for this exercise was to get an extensive understanding of the field of study, identifying gaps in the literature and the different approaches described. Although it is not likely that anyone would have carried out the same research as this study intended to, Travis (2016) advises that someone would have almost certainly have tried to answer the sorts of questions that the study intends to address.

Data was collected from various sources, including government publications, published articles and reports, published and unpublished theses, conference papers, presentations, and online articles. Data collected from these sources included drought impact assessments, agricultural water use coping and adaptation strategies adopted by other smallholder farmers in different countries, South Africa and the Western Cape province. Also covered were factors hindering the adoption of such strategies. Successful and proactive strategies identified from the literature were documented to be compared to the agricultural water use strategies currently practised by smallholder farmers in two selected WC districts. Factors that hindered smallholder farmers in certain regions were also documented to compare with the ones identified in the selected districts. From the data collected from these various sources, gaps were identified in the knowledge and adoption of drought strategies by smallholder farmers from the WC province. Also identified was the absence of proper knowledge of how different institutions can assist smallholder farmers to build resilience towards drought periods.

3.5.2. Data collection for Objective 2

Identify and describe different coping and adaptation strategies for agricultural water use adopted by smallholder farmers in the Overberg and West Coast district municipalities in the Western Cape province.

According to Eriksen et al. (2008), there are many traditional strategies to cope and adapt to detected changes in climate. These strategies require a certain degree of flexibility and room for manoeuvring to strengthen smallholder farmers' coping and adaptation capacity. To assist smallholder farmers during drought periods the South African government responded with drought relief programmes to assist smallholder farmers. However, drought relief only addresses immediate needs instead of building resilience towards droughts (Bahta et al., 2016). The recurrence of severe droughts demonstrates the significance of reducing impacts associated with drought through the development of drought resilience strategies (Bahta et al., 2016).

Drought is causing steadily increasing competition for water resources for agricultural use. This will negatively impact food security levels in the province (WCDoA, 2017). It is therefore imperative to identify and describe the agricultural water use coping and adaptation strategies adopted by smallholder farmers in the Overberg and West Coast district municipalities in the Western Cape province. This will assist them to be able to withstand the extreme droughts anticipated in the future.

Data obtained about the coping and adaptation strategies adopted by farmers was inserted on a Word document for each farmer. All 100 created data scripts were inserted into Atlas *ti* version 8. Two projects were created on Atlas *ti*, for the West Coast and the Overberg, to be able to analyse each data set separately. Textual codes were created and all the documents were coded to allow the grouping of similar responses and comparisons among them. Networks were created to show how responses related to each other and how many farmers responded the same way. Interesting responses were also coded using in vivo coding for quotation purposes during the results write-up. Further data were analysed through a code-document table to generate frequencies. Since all the data is qualitative, a similar procedure was followed for the data obtained from the focus group discussions. A Hyogo Framework of Action (HFA) was employed for analysis of the data. The framework has 5 principles aimed at ensuring the reduction of impacts caused by various disasters and building resilience among vulnerable individuals towards such disasters (Zhou et al., 2014). All 5 principles were followed to reach a reasoned conclusion and make appropriate recommendations. The data obtained from focus group discussions were also coded on Atlas *ti*, using textual labels.

Networks derived from the analysis are presented as figures to show relationships among responses. The data is presented in narrative form and also tabulated. From the data obtained, this study identified the agricultural water use coping and adaptation strategies adopted by crop and livestock farmers to conserve water during drought periods in the two districts. These strategies are tabulated per district for comparative purposes.

3.5.3. Data collection for Objective 3

Analyse factors influencing the adoption of drought coping and adaptation strategies for agricultural water use by smallholder farmers in the Overberg and West Coast district municipalities in the Western Cape province.

There are several effective and robust strategies available that will help minimise adverse drought impacts. But because some of these strategies are associated with factors that hinder smallholder farmers from adopting them, it is critical to analyse these factors to be able to build smallholder farmers' resilience towards drought (Tazeze et al., 2012).

Objectives 2 and 3 both required explorative study to attain, and hence the same survey approach using a semi-structured questionnaire for face-to-face interviews was employed for objective 3. Focus group discussions were also conducted to validate the data and gain further understanding of the challenges that smallholder farmers perceive as hindrances when it comes to implementing known strategies for coping and adapting to drought. All interviews were recorded with the permission of the participants and then transcribed.

All the data obtained was qualitative. The data were analysed with the help of Atlas *ti* version 8. All the processes followed for analysing the data for objective 2 were also followed for this objective. Networks derived from the analysis are presented as figures to show relationships among responses. The data is presented in a narrative form and is also tabulated. In this way, the study identified factors that hinder the adoption of known strategies in the selected districts.

Data for farmers' characteristics and all the quantitative data was encoded on Statistical Package for the Social Sciences (SPSS) datasheets and analysed. Descriptive and inferential statistical analyses were used to identify percentages and frequencies. The percentages provided correspond with a number of responses provided because there were no responses in some questions. To summarise large sums of data descriptive statistics are employed (Nick, 2007).

3.6. Data analysis framework

The study employed the Hyogo Framework for Action (HFA) (2005). The HFA intends to ensure a reduction of impacts associated with disasters, drought in this case, in vulnerable societies and countries. The HFA framework has been endorsed by over 162 countries since

2005 (Zhou et al., 2014) and was found to be useful in many instances. Djalante et al. (2012) adopted the HFA to analyse the factors promoting and hindering resilience as well as arising issues in building resilience in Indonesia against natural hazards. The concept of resilience in the HFA was used as an underlying approach in reducing disaster risks (UNISDR, 2009). There has been a progress in minimising disaster impacts at local, national, regional and global levels in developing countries since the implementation of the HFA in 2005, leading to a decline in mortality rates caused by hazards (UNISDR, 2015).

However, even though there is noticeable progress in reducing disaster risk, disasters have continued to exert heavy expenses on communities and countries. Increasing frequency and intensity of disasters has significantly limited progress towards sustainable development affecting a large population in various ways. For example, the 2015-2018 drought led to severe declines in maize production from about 10 million tons in 2014/15 to about 7.3 million tons in 2015/16 (DAFF, 2015). It is therefore urgent and necessary to prepare and minimise disaster risk to plan for and reduce disaster risk to efficiently protect smallholder farmers (SHFs) and their livelihoods and strengthen their resilience. Reducing disaster risk is regarded as a profitable investment in preventing future impacts and losses caused by hazards (UNISDR, 2015).

In this study, HFA was used to identify and describe different coping and adaptation strategies for agricultural water use adopted by SHFs to minimise and prevent drought impacts, which will help build resilience for future drought impacts. Learning to adapt to drought through effective strategies can help build SHFs resilience thereby minimising impacts and drought vulnerability (Ubisi, 2016). Figure 2 shows how the selected HFA action areas link with the objectives of the study.

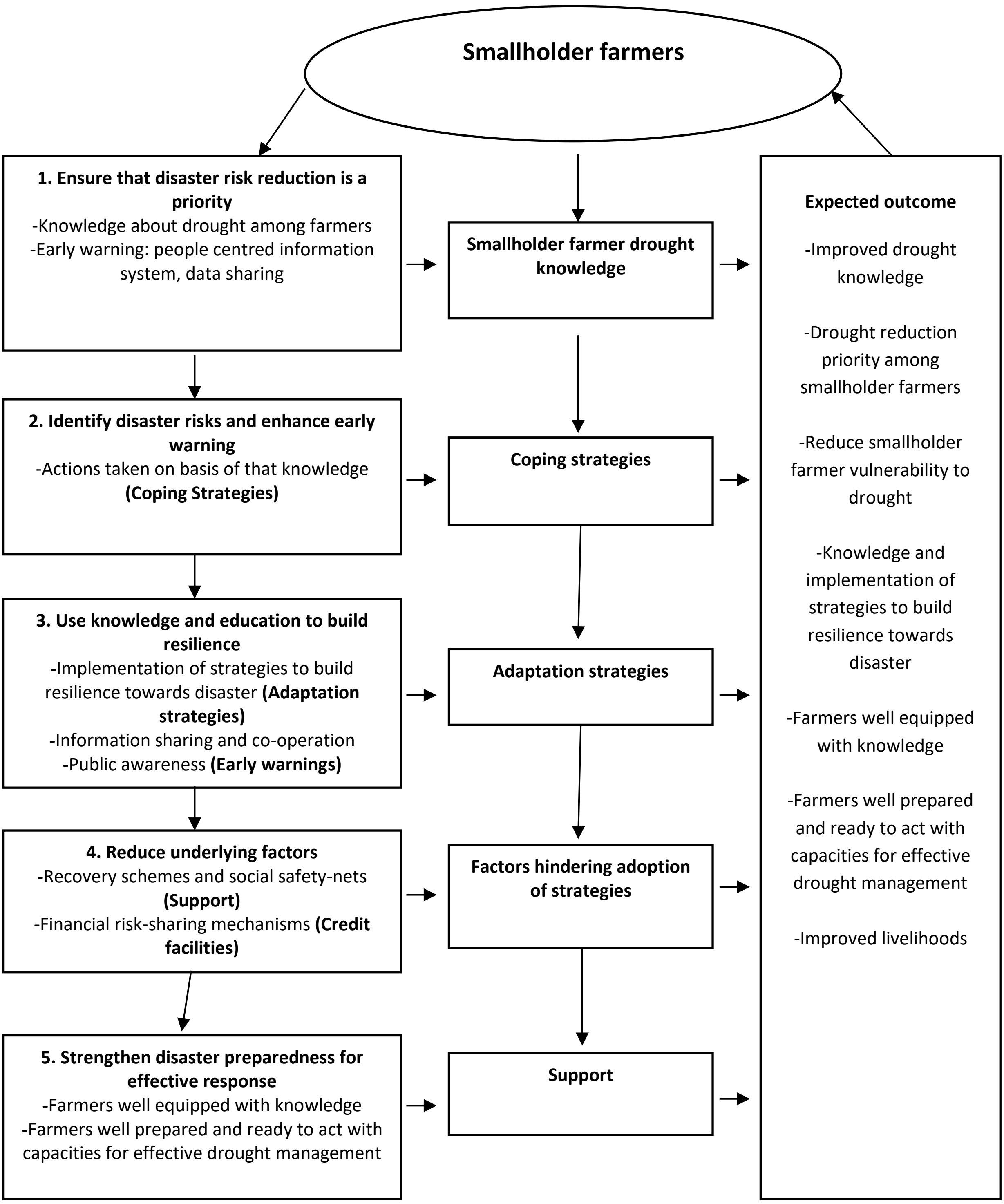

Figure 2: Hyogo Framework of Action: 2005-2015

There are five priorities of action that have been developed towards achieving the intended goal of the HFA framework. These priority actions are:

(1) making disaster risk reduction a priority; (2) knowing the risks and taking actions; (3) building the culture of resilience using all possible knowledge, innovation and as well increase understanding and awareness; (4) reducing risk factors through adequate risk management

techniques; (5) always be prepared and respond appropriately when necessary (Zhou et al., 2014). This study adopted all priority areas based on the aims of the study.

The study also identified factors that limit SHFs from adopting coping and adaptation strategies. This was done to help understand and address the factors effectively to help SHFs enable them to adopt both coping and adaptation strategies. This will help to promote the implementation of proposed strategies by SHFs.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1. Introduction

This chapter presents the research findings obtained from the responses of the smallholder farmers interviewed in the selected districts. The farmers remain anonymous as per the declaration in the consent letter. Those who are quoted are renamed to protect their anonymity. Results from the two districts will be presented separately for purposes of comparison. The questionnaire that was used as a guide for the interviews consisted of three sections, and this structure determined the way the results are presented.

1. **The first section** consists of farmers' characteristics that include the gender of the household head, age, years in farming, level of education and other characteristics
2. **The second section** comprises water and land resource information
3. **The third section** comprises drought information, divided into four parts: drought perception, coping and adaptation strategies, factors hindering adaptation, and support offered during drought.

Demographic information was gathered because it was thought that it might have some bearing on how farmers view or understand drought and how they respond to drought. For the study, the demographic data consisted of gender (of the head of the household, or the person responsible for the farming activity), age, years of experience in farming, education, farming enterprises, employment, family size, sources of income, land ownership.

4.2. Gender

Respondents were requested to indicate their gender by ticking the relevant option provided (male and female). Figure 3 presents the results of the gender distribution of the interviewed smallholder farmers.

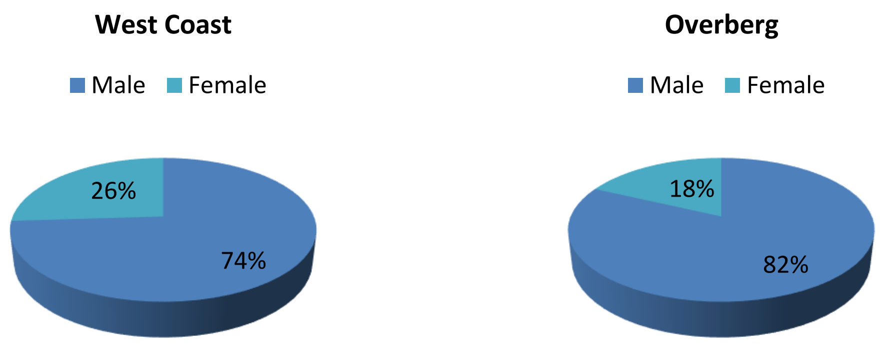

Figure 3: Gender distribution among smallholder farmers

About 74% of the smallholder farmers in the WCD were males. In the OD this figure was 82%. Males have traditionally participated more in agriculture than females. Graham (2012) similarly reported that only about 30% of the farmers interviewed were female.

4.3. Age ranges of the study participants in the sample

Figure 4 presents the age distribution among the smallholder farmers interviewed. Interviewees provided their actual ages so that precise discriminations can be made.

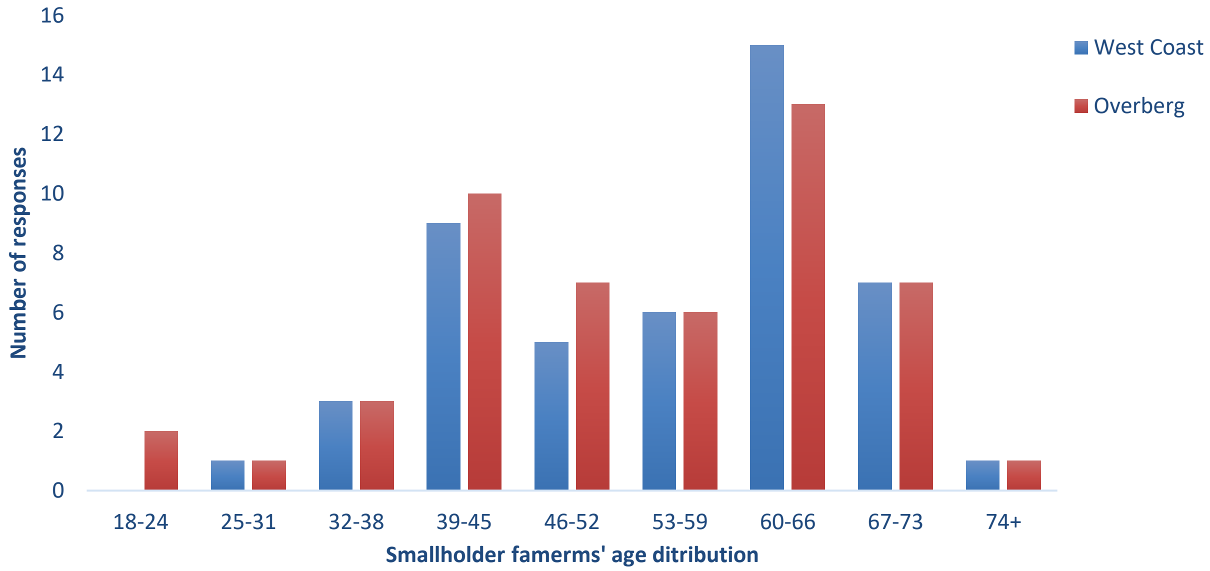

Figure 4: Age distribution of smallholder farmers

The average age for smallholder farmers was 54 years in the WCD and 52 years in the OD (the range was 18-74+ years). A large number of smallholder farmers (about 34% in the WCD and 26% in the OD) were in the 60-66 years category. Only six smallholder farmers were between the ages of 15 and 34, which in the South African context is described as “youth” (StatsSA, 2020). SHFs between the ages of 35-59 were about 47 in number. Similar results obtained from OECS reports were posted by Graham (2012), who found that farmers over 55 years of age amounted were 28%, while farmers under 25 years of age were 1%. Also, results from the 2010 survey of eight countries showed that 42% of farmers were between 41 and 55 years old (Graham, 2012). These results foretell a dire future for farming in the province when a dearth of farmers might threaten its food safety. FAO (2014) agrees that when old people outnumber young people willing to farm, food security is threatened (Muyambo et al., 2017).

4.4. Level of education

Farmers were requested to indicate the level of their education, and their responses are presented in Figure 5.

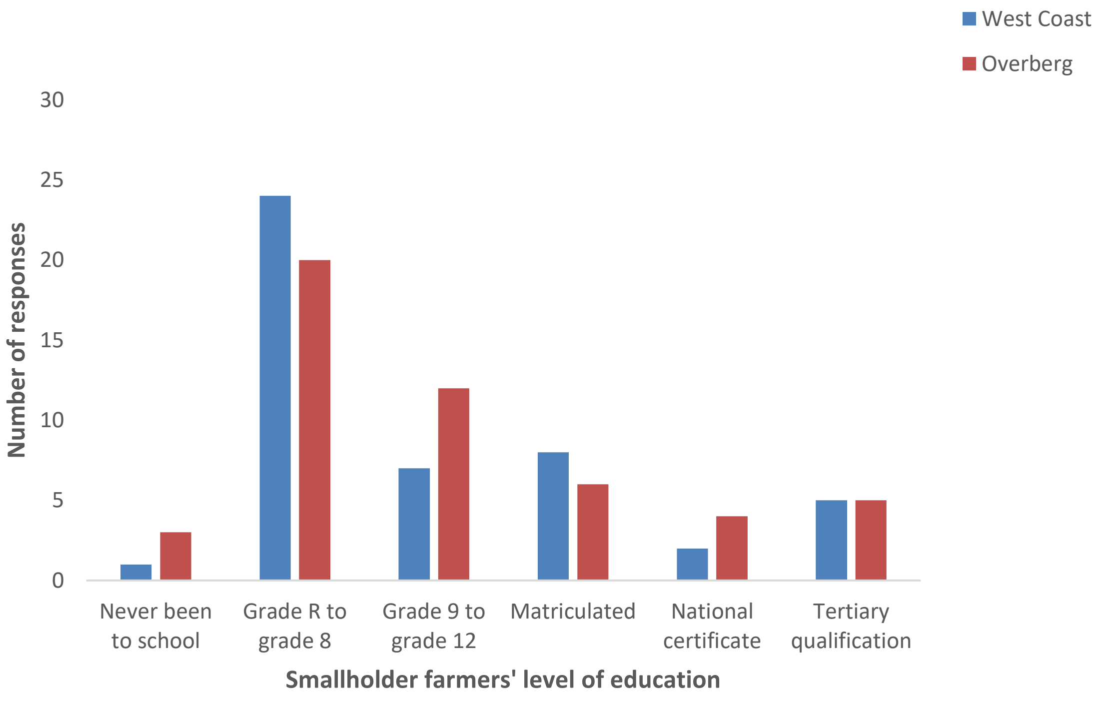

Figure 5: Level of education among smallholder farmers

Figure 5 shows that about 2% of smallholder farmers in the WCD and 6% in the OD had never been to school. Udmale et al. (2015) reported that about 9% of respondents in their study in India had no education. Smallholder farmers who had completed their primary education amounted to about 51% in the WCD and 40% in the OD. This indicates that most farmers can read and write. The literature reveals that the higher the education of farmers, the more easily they can interpret and understand information, which could enhance their coping and adaptative capacities to drought. Illiteracy is one of the factors that limit smallholder farmers' coping and adaptation capacity (Adekunle, 2013).

4.5. Farming enterprises

Figure 6 portrays the kinds of farming practised by smallholder farmers. In total, these amounted to eight.

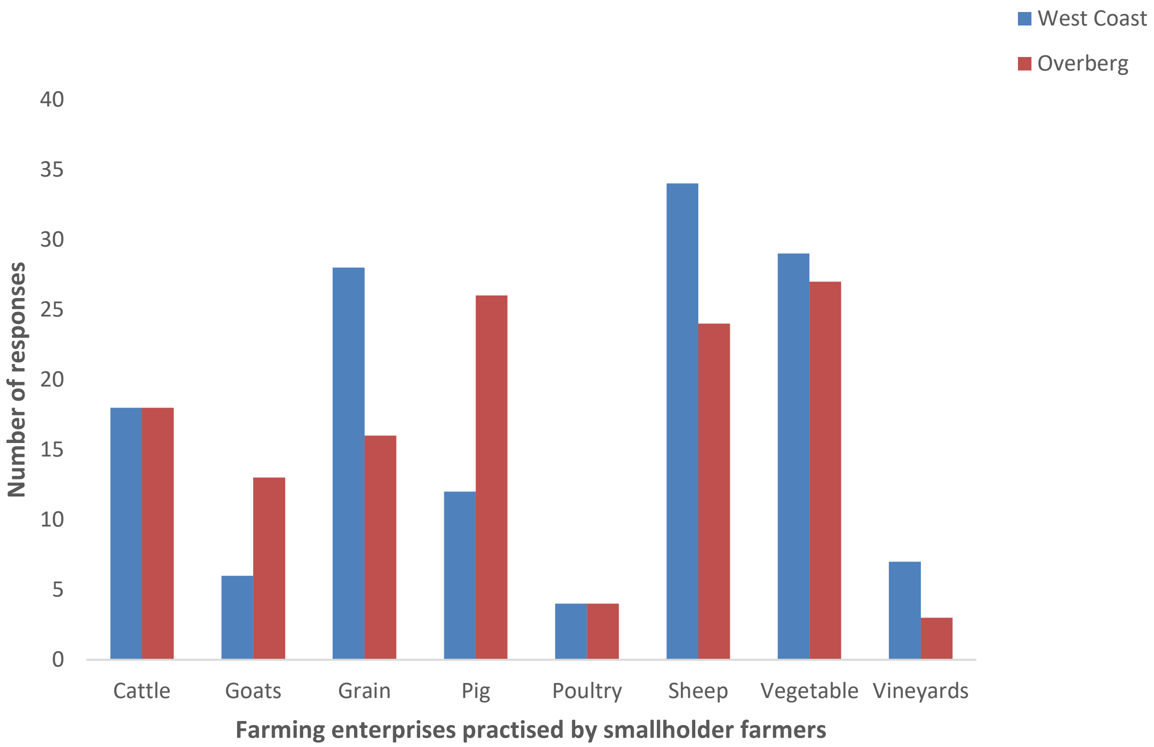

Figure 6: Farming enterprises practised by smallholder farmers

There were about 138 enterprises reported in the WCD and about 131 in the OD. Of the eight different enterprises in the WCD, sheep production accounted for 34 (25%), vegetables 29 (21%) and grain 28 (20%). These were the most practised. In the Overberg, the most practised were vegetable farming at 27 (21%), pig production 26 (20%) and sheep production 24 (18%). Goat production was not common in either district, even though they are considered drought-tolerant compared to sheep and cattle (Monteiro et al., 2017).

According to Graham (2012), smallholders traditionally practise a farming mixed of crops and livestock. This was evident in the case of the farmers sampled in these districts who mix crops (grain, wheat, lucerne), livestock and vegetables. Among the farmers interviewed, 98% view farming as a business. This tells us that farming is a source of income for these farmers. In Nigeria, smallholder farmers grow food and cash crops such as rice, wheat, cocoa and cotton (Morton, 2007), but in this study, smallholder farmers only produce small grain and vegetables.

According to Achterbosch et al. (2014), producing cash crops helps smallholder farmers to improve their livelihood by increasing income and reducing vulnerability. Also, cash crops encourage smallholder farmers to invest more in their farming and thereby improving their coping and adaptation capacity when disasters strike.

4.6. Sources of energy

Grid electricity was the main source of energy used in both districts, 53% and 59% in the WCD and OD, respectively. Figure 7 shows the various sources of energy used by smallholder farmers for agricultural purposes in both districts.

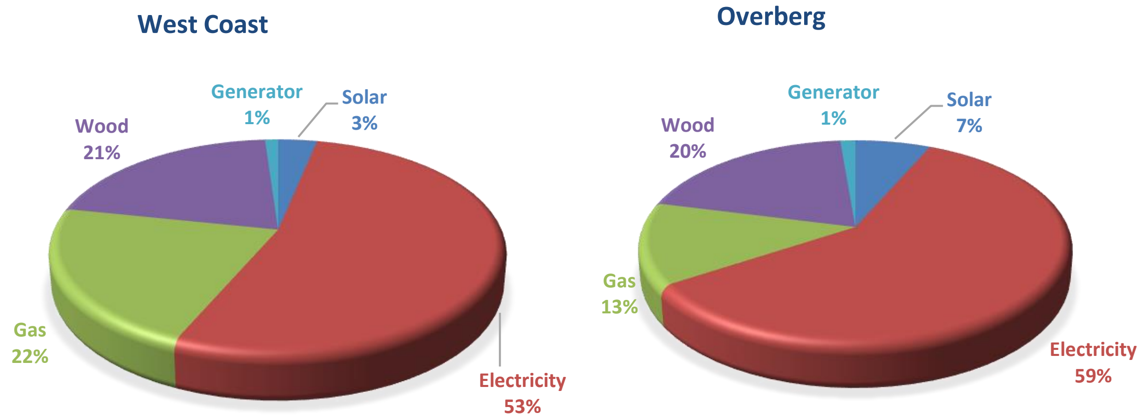

Figure 7: Sources of energy for agricultural use

In the WCD and OD, respectively, gas (22% and 13%) and wood (21% and 20%) were more widely used by smallholder farmers than solar energy (3% and 7%) and power from a diesel generator (1% and 1%). Electricity is one of the significant sources of energy used for agricultural activities in SA. Solar energy in the WC province is the only renewable energy accessible to farmers (GreenAgri, 2014; GreenCape, 2018). However, in this study, the use of solar was very low. In the study conducted by Fami et al. (2010) in Iran, solar was one of the main sources of energy for agricultural activities. However, even though solar energy was available there was a rising need for electrical energy because access to electricity allows the adoption of certain new agricultural water use strategies (Fami et al., 2010).

4.7. Family size and involvement in farming

About 60% of smallholder farmers (SHFs) had between 4 and 6 family members. About 62% of smallholder farmers in the WCD and 66% in the OD were farming individually without involving their family. Thus only 38% of smallholder farmers in the WCD and 34% in the OD involved their family members. The results from the focus group discussion confirm this, with farmers complaining that young people do not want to take part in farming and would rather go and look for jobs in the city. Morton (2007) claims that family involvement is an important factor in a farmer's resilience in the face of drought. Larger households engage more in farming activities since labour is readily available (Subakanya, 2015).

4.8. Farming method

Farmers who farm as a group are regarded as more productive and usually cope with and adapt better to drought periods. This is because they are said to share information on drought strategies and seek help together or from each other (Senyolo, 2018). When the smallholder farmers in this study were asked if they farmed in groups about 48% of SHFs in the WCD and 44% of SHFs in the OD were farming in groups. This meant that about 52% in the WCD and 56% in the OD were farming individually. During follow-up focus group discussions SHFs had differing views on farming in groups. Figure 8 shows the results of the focus group discussions on smallholder farmers' methods of farming in the West Coast District.

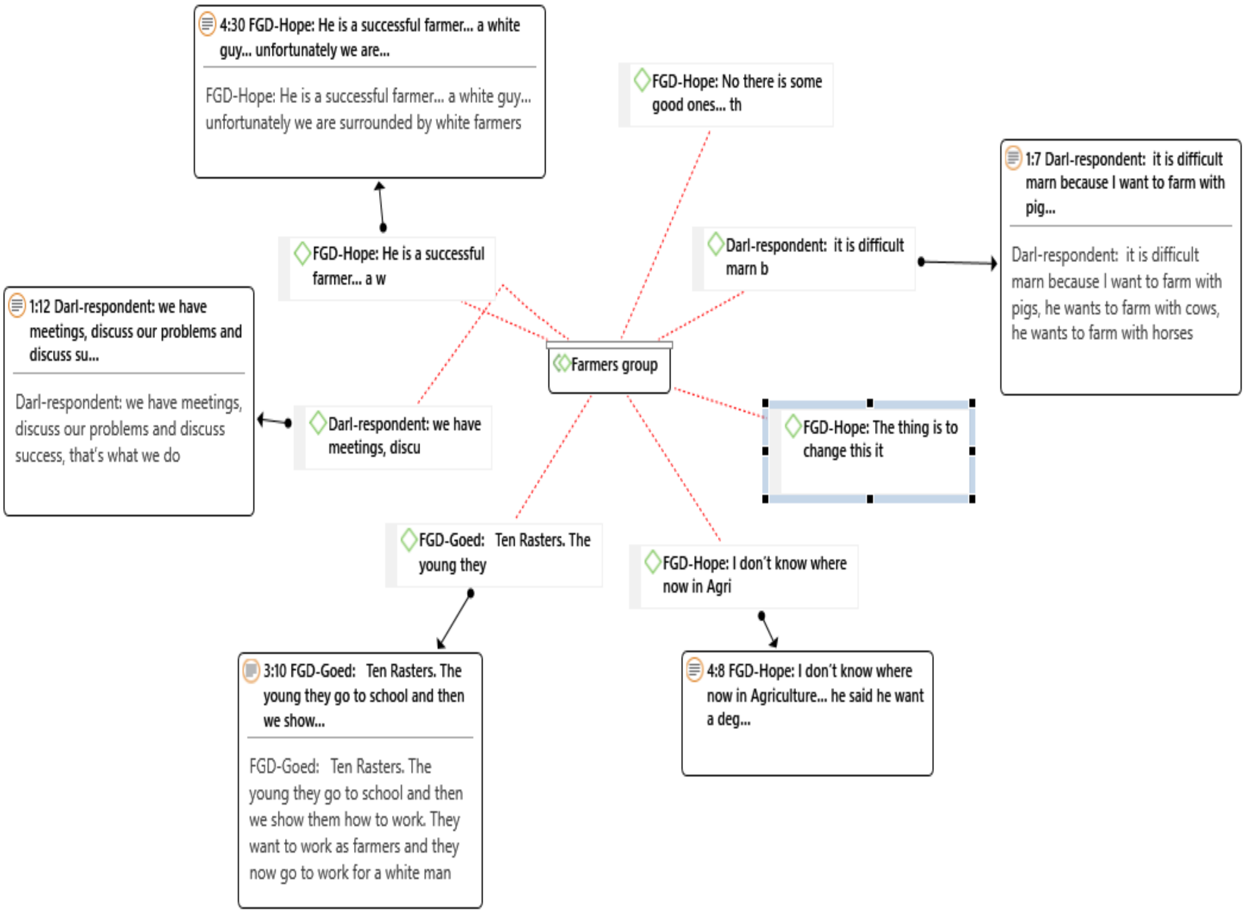

Figure 8: Methods of farming among smallholder farmers in the WCD
(FGD-HOPE: stands for focus group discussion in Hopefield, DARL-RESPONDENT: stands for Darling respondents, FGD-GOED: stands for focus group discussion in Goedverwacht)

During focus group discussion in Goedverwacht (FGD) in the OD, smallholder farmers mentioned several advantages associated with group farming such as sharing ideas and information. Various studies also show that farmers farming in groups get to share information among themselves and it assists farmers to adopt new coping and adaptation strategies (Munasib & Jordan, 2011; Mulwa et al., 2017). Figure 9 shows the advantages of farming as groups as perceived by the farmers from the Overberg District.

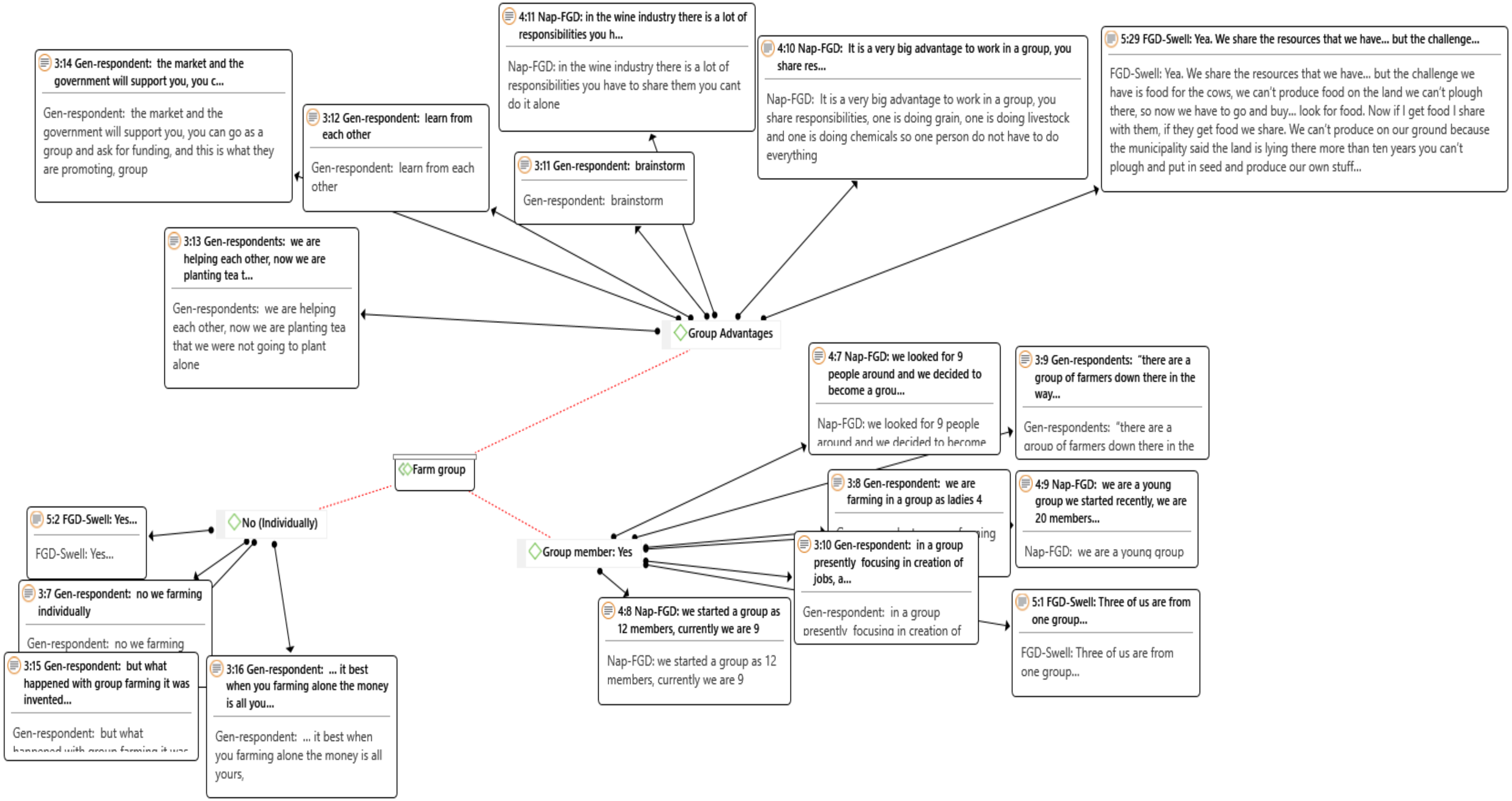

Figure 9: Advantages of farming as a group in the Overberg Focus Group Discussion (FDG)
(Gen- stands for Genadendal, Nap-FGD- stands for Napier focus group discussion, FGD-SWELL- stands for focus group discussion in Swellendam)

Smallholder farmers (both farming individually and in groups) made use of casual labour: about 92% in the WCD and 80% in the OD (i.e. only about 8% in the WCD and 20% in the OD did not use casual labour). These results contradict the conclusion of Leonardo et al. (2018) which showed that smallholder farmers in rural Mozambique relied mostly on their labour. In Free State smallholder farmers want to hire casual labour but due to limited total income received they could not, only 15% hired casual labour (Myeni et al., 2019). Casual labour helps smallholder farmers to adopt strategies such as rainwater harvesting and conservation agriculture (Ngwira et al., 2014). The farmers in the study hired casual labour on a weekly, quarterly, seasonal, or yearly basis. Only about 30% of smallholder farmers in the WCD and 30% in the OD had permanent employees. Farmers said that their income fluctuated, especially during drought periods, and they found it difficult to commit to permanent employees.

4.9. Farmers group activities

Smallholder farmers in groups engaged in meetings to discuss various matters that affected their farming, whether positively or negatively. The network diagram from the analysis is provided as an annexure. In the WCD, farmers were reluctant to specify activities, so there was a general code for farming activities (23%). Other activities included discussion of plans (12%), water (11%), land (10%) and finances (7%). Few farmers mentioned discussion of challenges faced, climate change or sharing knowledge. In the OD, the discussions mainly involved farm-related activities (16%) and land (16%). Other matters discussed included the way forward in farming (9%) and water (9%). Few farmers mentioned discussion of service providers (6%), finances (5%) and climate change-related disasters such as drought (3%). The results showed that SHFs engaged in these discussions to help improve their farming, though there were surprisingly few sessions covering drought-related matters.

The results indicated that SHFs from both districts had been farming for some years. SHFs had variously been farming for 0-3 years (14%), 4-6 years (20%), 7-9 years (12%) and 10 and above years (54%). According to the literature, farmers who have been farming for many years should have acquired the experience and skills to cope with and adapt better to drought conditions (Mdungela et al., 2014; Muema et al., 2018).

4.10. Modes of communication

Farmers made use of various modes of communication to access information. Figure 10 shows the six communication methods used by smallholder farmers in both selected districts.

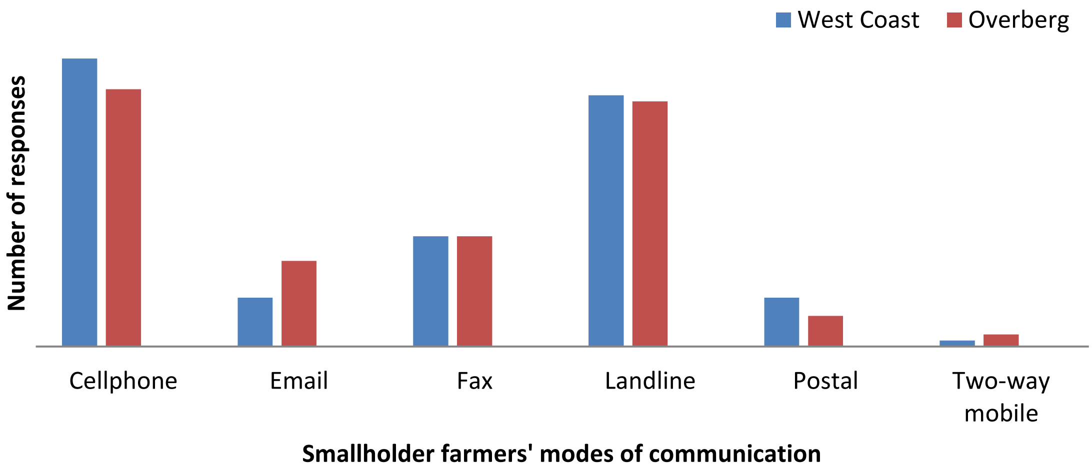

Figure 10: Smallholder farmers' modes of communication

From both districts, a cell-phone (38%; 35%) and landline (33%; 33%) were the main modes of communication. Through the use of cell-phone farmers are able to access weather-related information and awareness, thereby helping farmers to make informed decisions (Tadesse & Bahiigwa, 2015; Masuka et al., 2016). The use of email was low, at about 7% in the WCD and 12% in the OD, which might be because there are few young people. Studies report that the youth make use of email on their smart phones (Sooryamoorthy, 2015). Surprisingly, the use of postal services ranked low (7%; 4%) in the WCD and OD respectively, even though most of the farmers involved were elderly.

4.11. Farmers' events

Agricultural Extension Officers assisted smallholder farmers to conduct various events to enhance their farming skills. Figure 11 shows the distribution for such events.

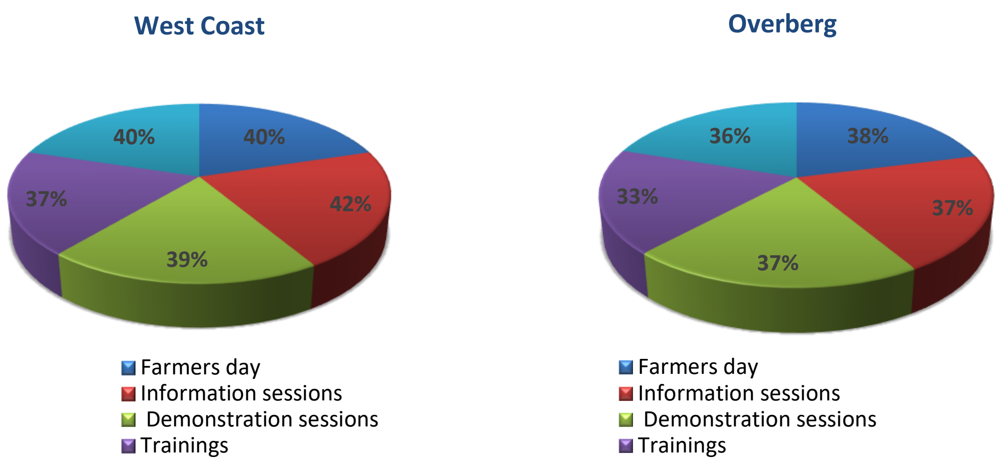

Figure 11: Smallholder farming-related events

The results show that SHFs were aware of different events and attended them in both districts. This implies that farmers were exposed to information and skills training. Besides attending these events, the smallholder farmers were asked if they had received any agricultural training. About 70% of smallholder farmers in the WCD and 50% in the OD had received some training, the balance, none. The training received by smallholder farmers is presented in Figure 12 as a network (from Atlas *ti.* Networks). In this section, the farmers are named according to Atlas *ti* generated codes, for example in **EBE04 NWS (EBE=Town, 04 =Questionnaire number and NWS= District).**

Training received in the WCD included livestock production (27%), including cattle, goats, pigs and sheep, vegetable production, including soil preparation (12%), farm management (9%) and finance management (7%). About 7% of these SHFs had learned to farm on their own, with no formal training. A few farmers received training on administration, crop production, health and safety, and how to operate infrastructure. Farmer **KOE10NWC** mentioned that they were trained on how to plant vegetables and vineyards and told about water systems. ***KOE10NWC:*** *"Vegetable and vine production, first aid, harvest machines, tractor driving and use of implements on everything we are doing and computers of pump stations and water systems".* Training on-farm management accounted for 9%, mostly via short courses. For example, farmer **HOP49SWC** obtained quite a number of National Diplomas on business-related studies. **HOP49SWC:** *"National Diploma in Purchasing Management; National Diploma in Business Management; National Diploma in Procurement and Material Management".* Farmers who farm with crops also received training, in grain production, lucerne and vineyards. This training accounted for 8% of all the training undergone. There were some farmers (about 7%) who had received no formal training but claimed to have trained themselves: ***DAR43SWC:*** *"Learned farming at home" ….* ***EBE13NWC:*** *"None. I train myself, learn from a white farmer"*

…. Other farmers used to be farmworkers before they started their farming... ***CLA30NWC:*** *"My experience on farms where I worked" ….* In the OD, farmers mostly received training on-farm management (17%), crop production (15%) and livestock production (10%). Livestock training ranked quite low in comparison to the figure for WCD. Other training included poultry, wool production, viticulture, project management and training on infrastructure operation. Most farmers did not receive formal training on how to grow crops and manage their livestock. Yet it is believed that when SHFs receive formal training, the benefits are substantial because the training helps them to acquire the adaptive capacity to react flexibly to disasters and challenges (Kiptot & Franzel, 2015). The farmers were also asked if they received any other training besides agriculture-related training, and about 29 (58%) SHFs in both districts answered in the affirmative.

4.12. Skills development

Even though some smallholder farmers received training, about 93% of SHFs in the WCD and 92% in the OD needed skills development. The problems and constraints faced by these smallholder irrigation schemes can be classified as both external and internal. Mvelase (2016) says that smallholder farmers in South Africa lack skills and this affects their productivity and farm income generated (Khoza et al., 2019). Smallholder farmers have always been known for being short on farming skills, which of course impedes their growth (Khapayi & Celliers, 2016). The smallholder farmers were, therefore, requested to describe what skills development they needed. Results are presented in Figure 14 for the WCD and in Figure 15 for the OD.

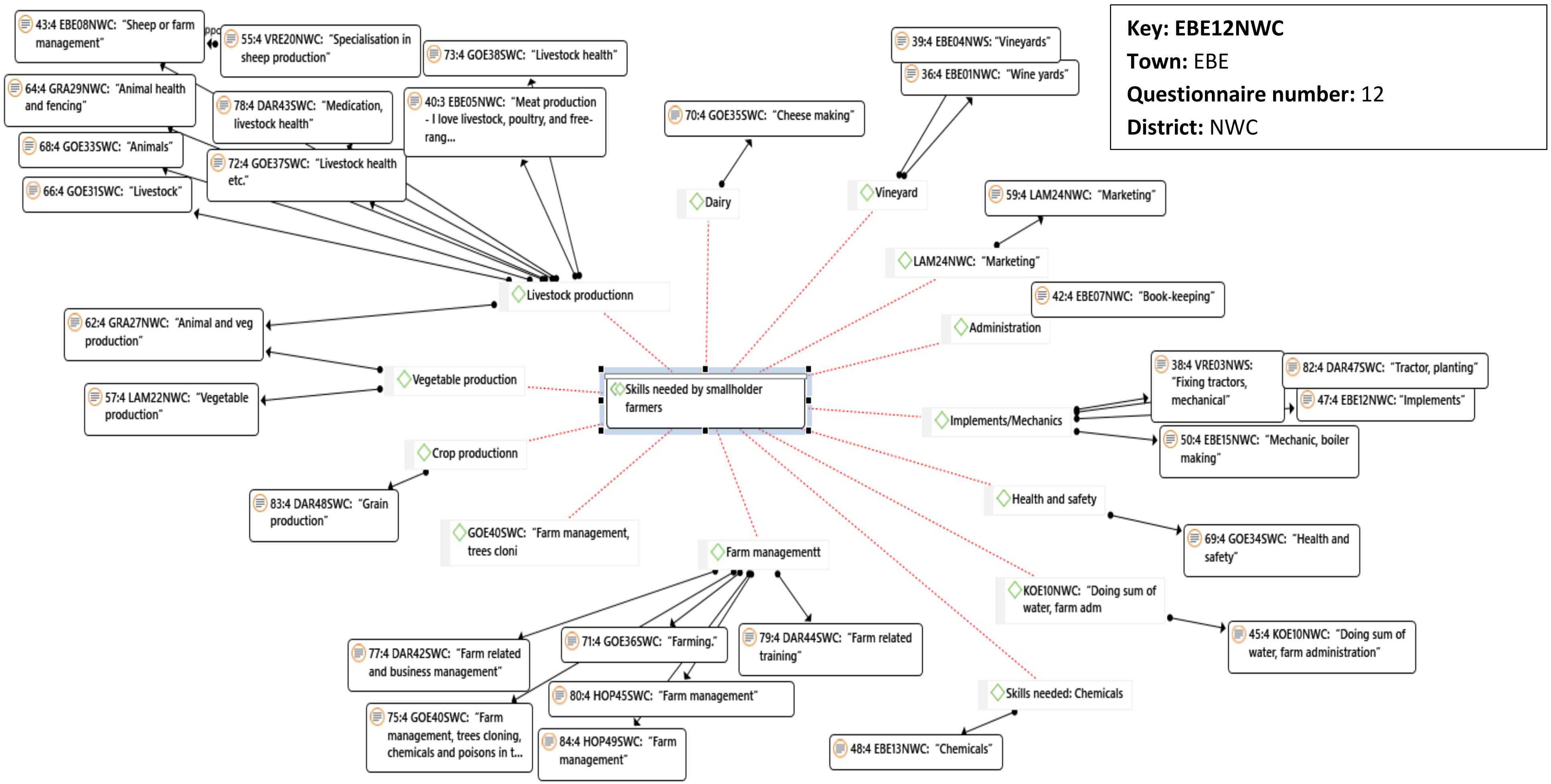

Figure 12: Skills development needed by smallholder farmers in the West Coast District
*(**Towns:** EBE- Ebenhaezer, LAM- Lamberts Bay, VRE- Vredendal, DAR- Darling, GOE- Goedverwacht, KOE- KOE- Koekenaap, HOP-Hopefield, GRA- Graafwater. **Districts:** NWC- North West Coast, SWC- South West Coast)*

Training in livestock production (pig, sheep, cattle) (40%) was the main skill needed, including instruction in livestock health. Farmers were very zealous to be trained in keeping animals healthy.

Other skills development needed was farm management (21%), comprising any agricultural-related training. For example, farmer ***KOE10NWC*** mentioned that he had received some training in calculating the water needs of crops. However, he needed training to use water sparingly for irrigation, especially during drought periods when water is very scarce. On farm-related training, farmer ***GOE40SWC*** remarked: "To get skills on trees cloning, chemicals and poisons in the soils, animal vet." Farmers added that it would be really helpful if some of them could be trained to perform veterinarian services.

Farmers mentioned skills development in using implements and mechanics (11%): they wanted to be taught how to fix and operate implements. Skills development for vegetable farming (8%) and crop production (8%) ranked quite low, even though vegetable production was among the most practised enterprise in the region. Only a few farmers mentioned the need for skills development in respect of vineyards (5%), health and safety (3%), administration (3%), dairy production (3%), or the use of chemicals (3%).

Key: EBE12NWC
Town: EBE
Questionnaire number: 12
District: NWC

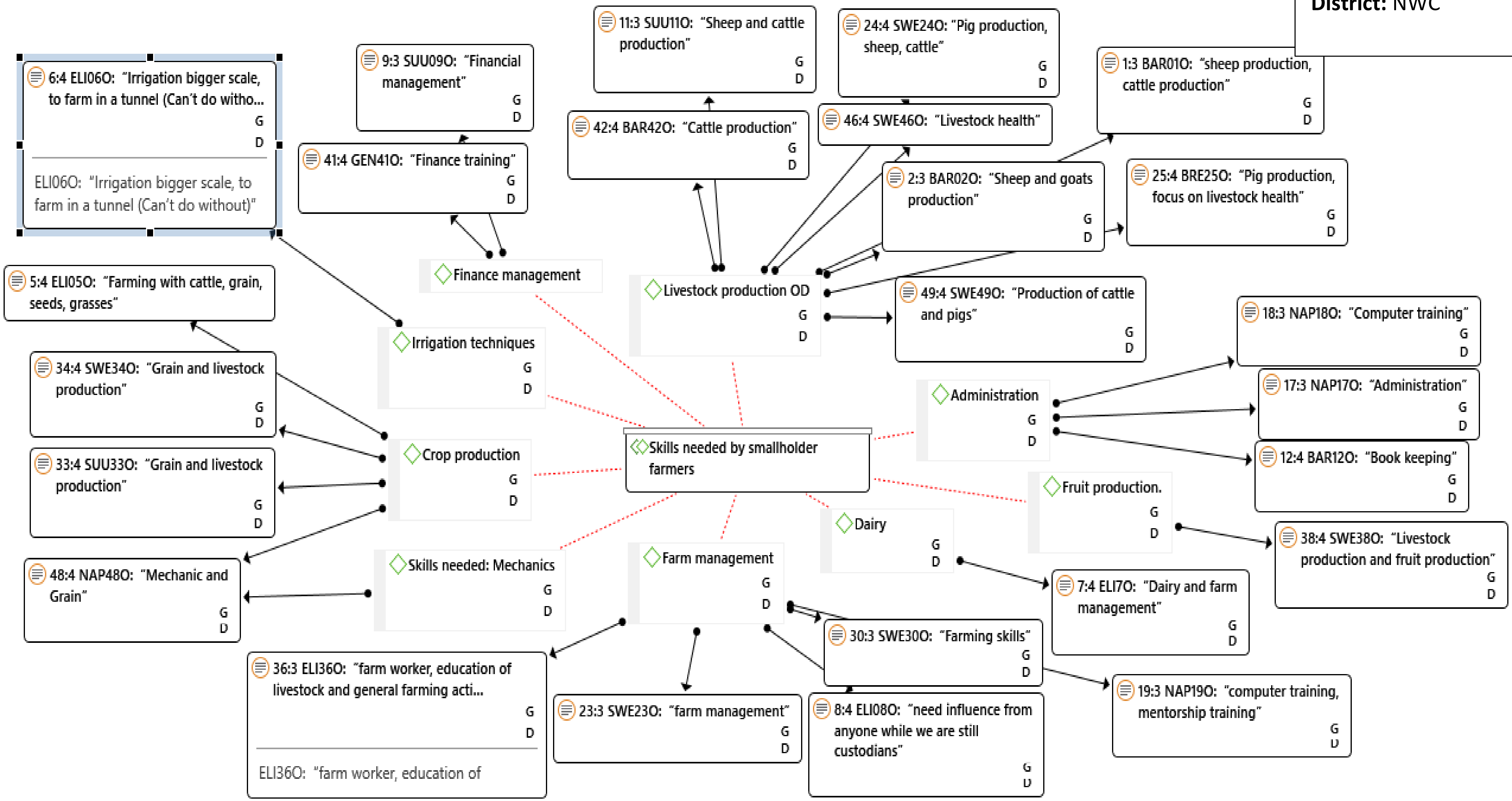

Figure 13: Skills development needed by smallholder farmers in the Overberg district
(Towns: SUU-Suurbraak, SWE- Swellendam, BAR- Barrydale, NAP- Napier, ELI-Elim, GEN- Genadendal. District: O- Overberg)

Similar to the WCD, there was a broad consensus that livestock production (43%) was the most needed skill, which included livestock health. For example, farmer **BRE25O** mentioned that he would be happy to be trained on pig production but focus mainly on pig health. Farm management was mentioned by 14% and included any farming-related skills. Farmers showed interest in receiving training to improve their farming:

ELI08O "*We need influence from anyone while they are still custodians"*

ELI06O "*I cannot manage not to be taught big-scale irrigation and to farm in a tunnel."*

Smallholder farmers in OD reasoned that there would be many more smallholder farmers growing vegetables, but irrigation requires a lot of water so they preferred to play it safe with livestock. Thus, due to water shortages and their lack of irrigation technique knowledge farmers are turning away from growing vegetables to raising livestock. Schreiner et al. (2018) confirm that to grow vegetables requires the use of large quantities of water.

4.13. Sources of income

About 98% of smallholder farmers from both districts were otherwise employed. Most smallholder farmers, therefore, had more than one source of income, as is portrayed in Figure 14.

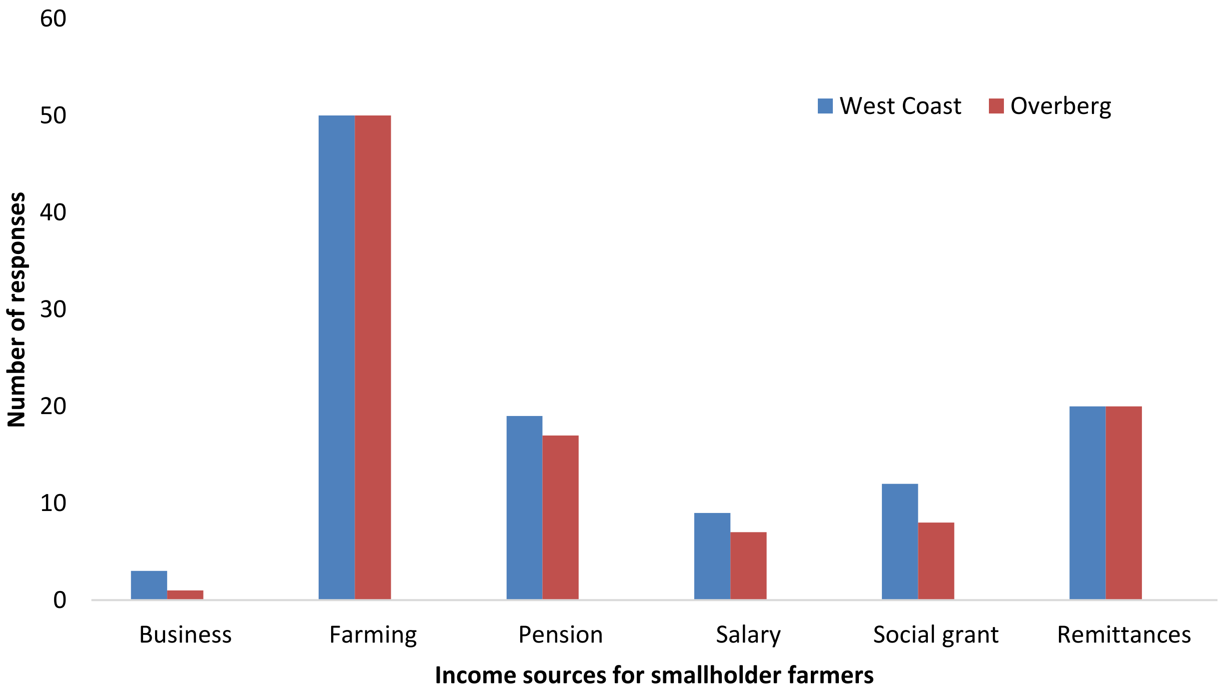

Figure 14: Income sources for smallholder farmers

Of all income sources, farming was the main source of income for about 44% of SHFs in the WCD and 49% in the OD. This suggests that agriculture was the primary livelihood activity for smallholder farmers, unlike the findings of Myeni et al. (2019) that farming was the primary occupation but the off-farm salary was the main source of income for most families. The results showed that SHFs were also dependent on pension grants and remittances for additional income. Only 3% of smallholder farmers in the WCD and 1% in the OD had small businesses. Remittances were mainly from SHFs' children.

The results obtained from focus group discussions on SHFs' sources of income are presented in Figures 15 and 16. In the West Coast district, farmers who depended mainly on farming for their livelihoods accounted for 60%, 19% depended more on employment, and 10% on businesses. The businesses included running a taxi service and retail. Some farmers do volunteer work (4%) and fishing (6%), which they do not regard it as part of farming.

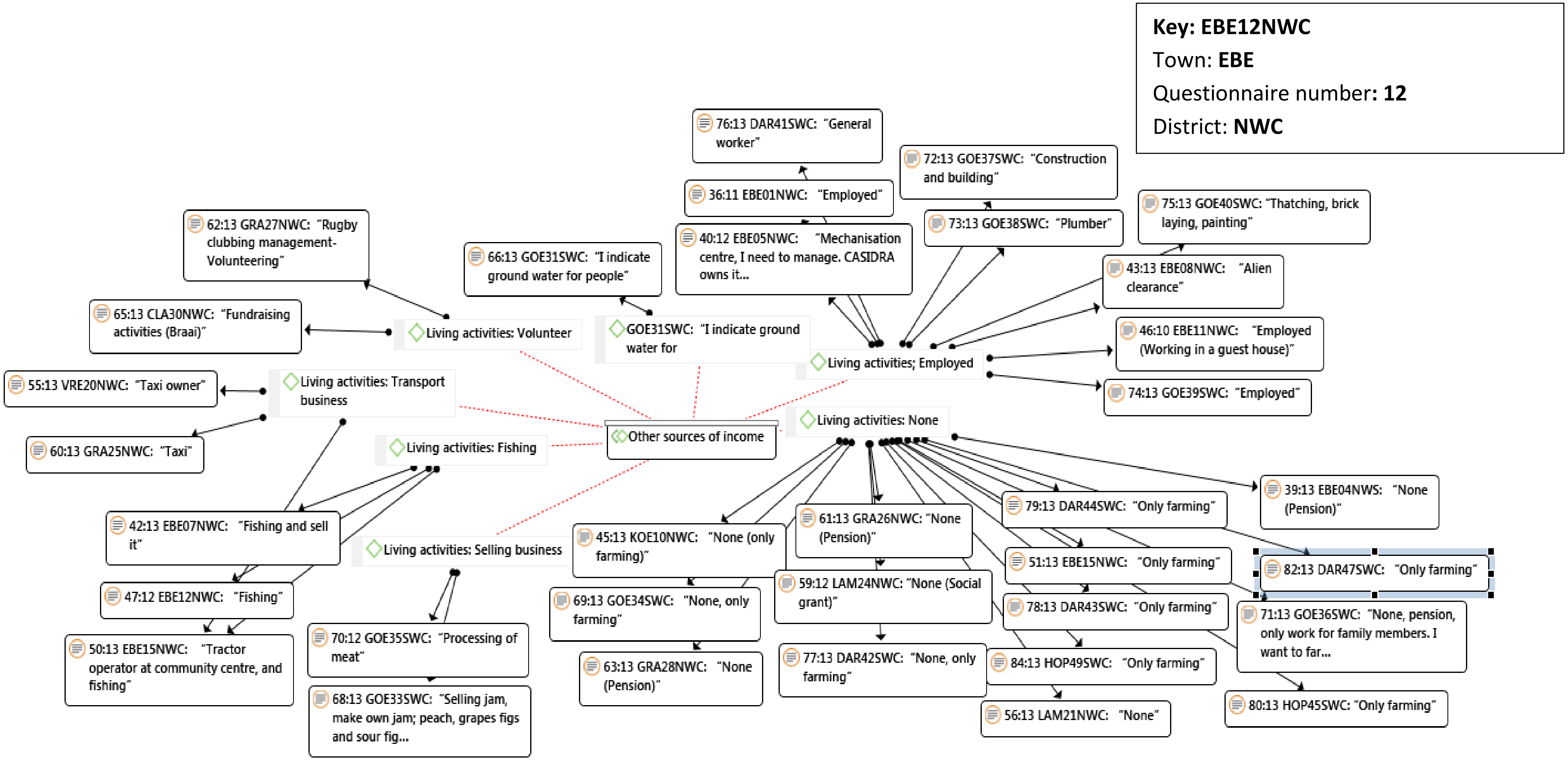

Figure 15: Sources of income for smallholder farmers in the West Coast District
*(**Towns:** DAR-Darling, EBE- Ebenhaezer, GOE-Goedverwacht, HOP-Hopefield, LAM-Lambertsbaai, GRA-Graafwater, VRE-Vredendal, CLA-Clanwilliam. **Districts:** NWC-North West Coast, SWC- South West Coast)*

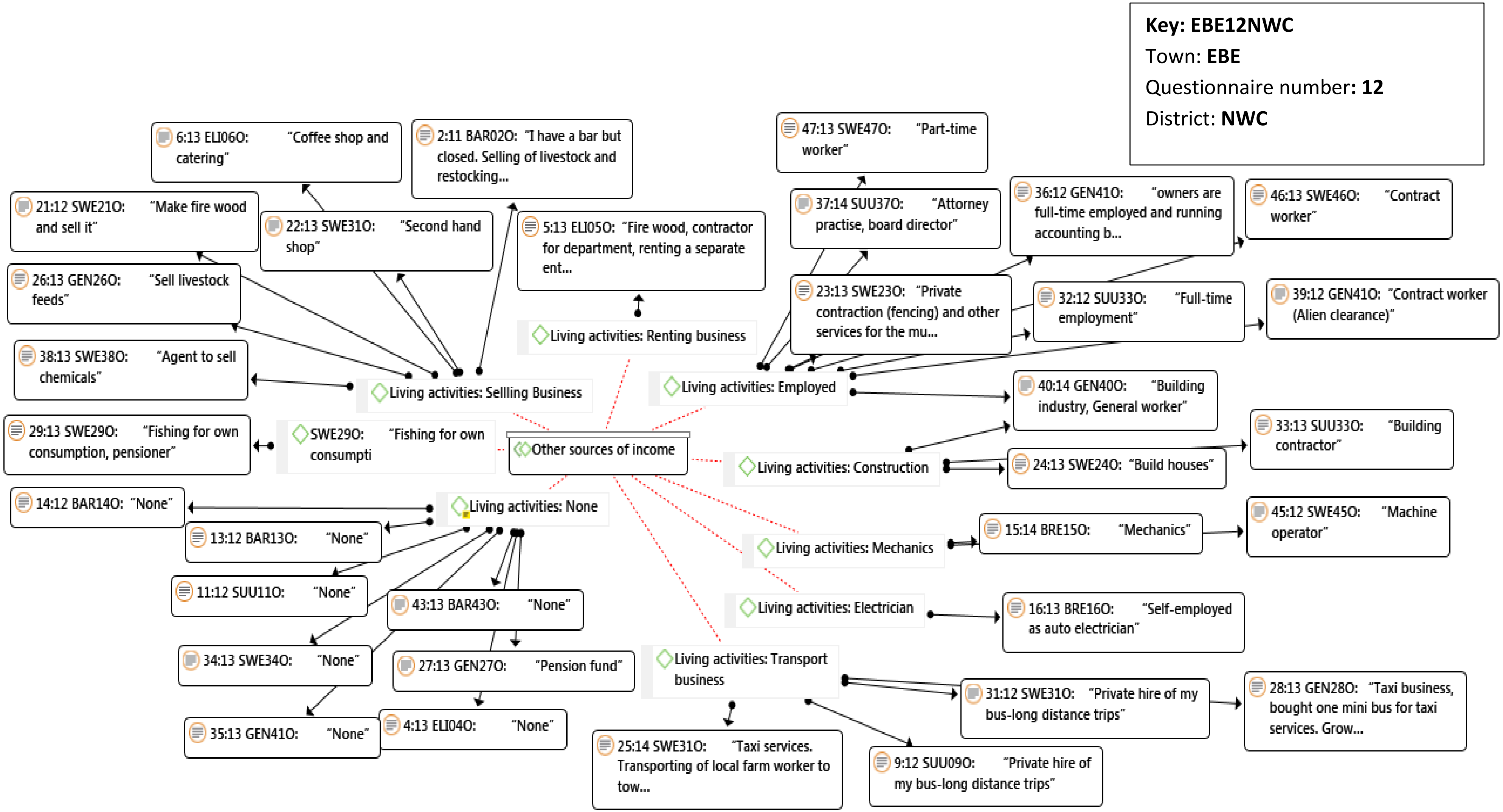

Figure 16: Sources of income for smallholder farmers in the Overberg district
*(**Towns:** SWE- Swellendam, GEN- Genadendal, BAR- Barrydale, ELI- Elim, SUU- Suurbraak. **District:** O- Overberg)*

About 40% of farmers were wholly dependent on farming for their income. Among farmers who depended mainly on farming were some who also received pensioner grants and social grants. As many as 35% were receiving a salary from part-time, full-time or contract employment. Other farmers (25%) received income from business interests.

The smallholder farmers surveyed in this study mostly rely on farming for their livelihood, though many derive additional income from non-farming activities. These findings are in contrast with those of Kuivanen et al. (2016), who reported a low level of dependence among smallholder farmers on non-farming activities in Northern-Ghana. Smallholder farmers employ various methods of saving income generated, as presented in Figure 17.

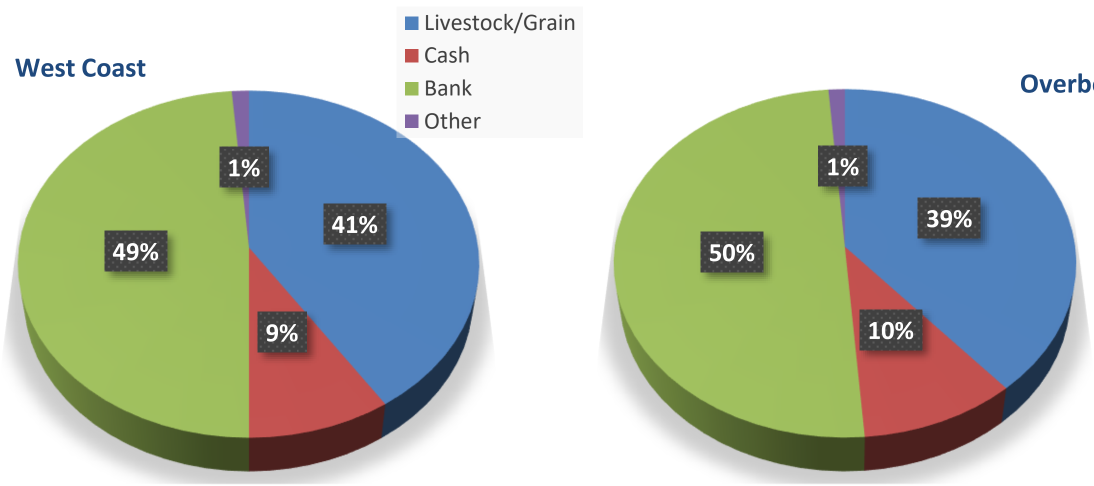

Figure 17: Smallholder farmers' methods of saving money

Results show that farmers were mainly saving money in commercial banks in both districts. Purchasing livestock or grain was the second most common method of saving money among the SHFs in both districts. Smallholder farmers saw purchasing livestock in particular as a form of insurance and saving money. These findings were consistent with findings by Onono et al. (2015) who found that in Kenya farmers viewed keeping livestock as a store of wealth besides performing social functions. One farmer in Goedverwacht said, "Cattle are a walking bank". Keeping cash at home was not an ideal option for smallholder farmers to save money. For ease of access and availability, SHFs preferred to keep their money in commercial banks (De Klerk, 2013).

Even though SHFs were able to save some money, there was a need for additional funds for SHFs because it is expensive to adopt certain drought strategies such as drilling a borehole (Muthelo et al., 2019). The conventional wisdom is that smallholder farmers do not have access to financial facilities such as credit and grants, exacerbating their vulnerability (Turpie & Visser, 2013). However, this was not the case in this study, with about 84% reporting access to credit facilities. During the FGD, however, smallholder farmers revealed that they did not have ready access and were not aware of whom to contact. SHFs who claimed they had access but could not borrow money cited various reasons, including challenges in selecting 5 members to represent the group, and the fact that their production was generating too little income to satisfy the bank. On the other hand, smallholder farmers who had no problem with credit borrowed money from cooperatives, commercial banks, and other unspecified organisations. The money is paid back at a certain interest rate, through contract farming or other methods as per agreement with the credit provider. Smallholders emphasised that they would love to borrow more money to help them buy facilities such as water tanks and water reticulation equipment to improve their productivity.

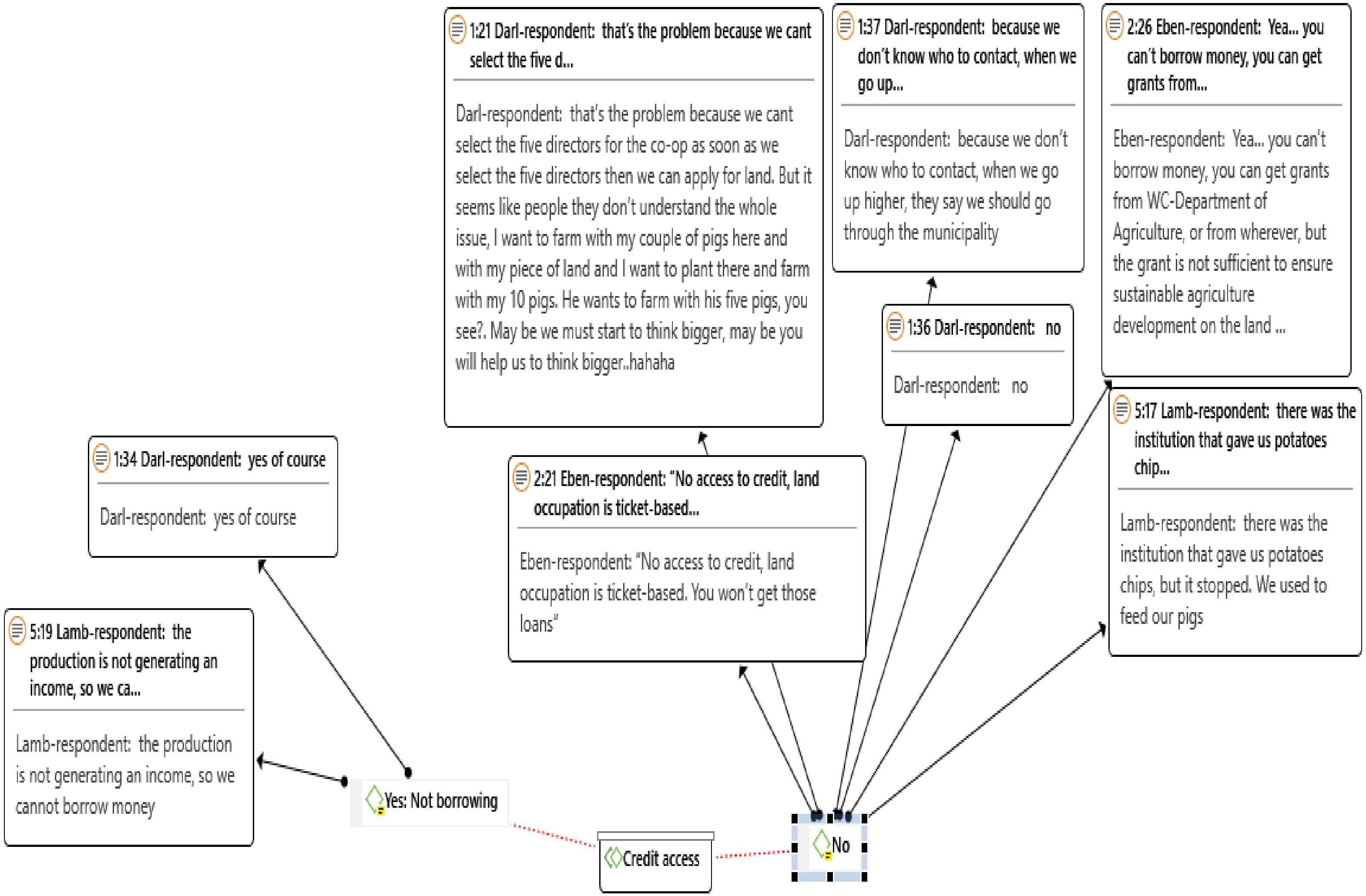

Figure 18: Focus group discussion on credit access in the West Coast district

(Lamb-respondents- stands for Lamberts Bay respondents, Eben-respondents- stands for Ebenhaezer respondents, Dal- respondents- stands for Darling respondents)

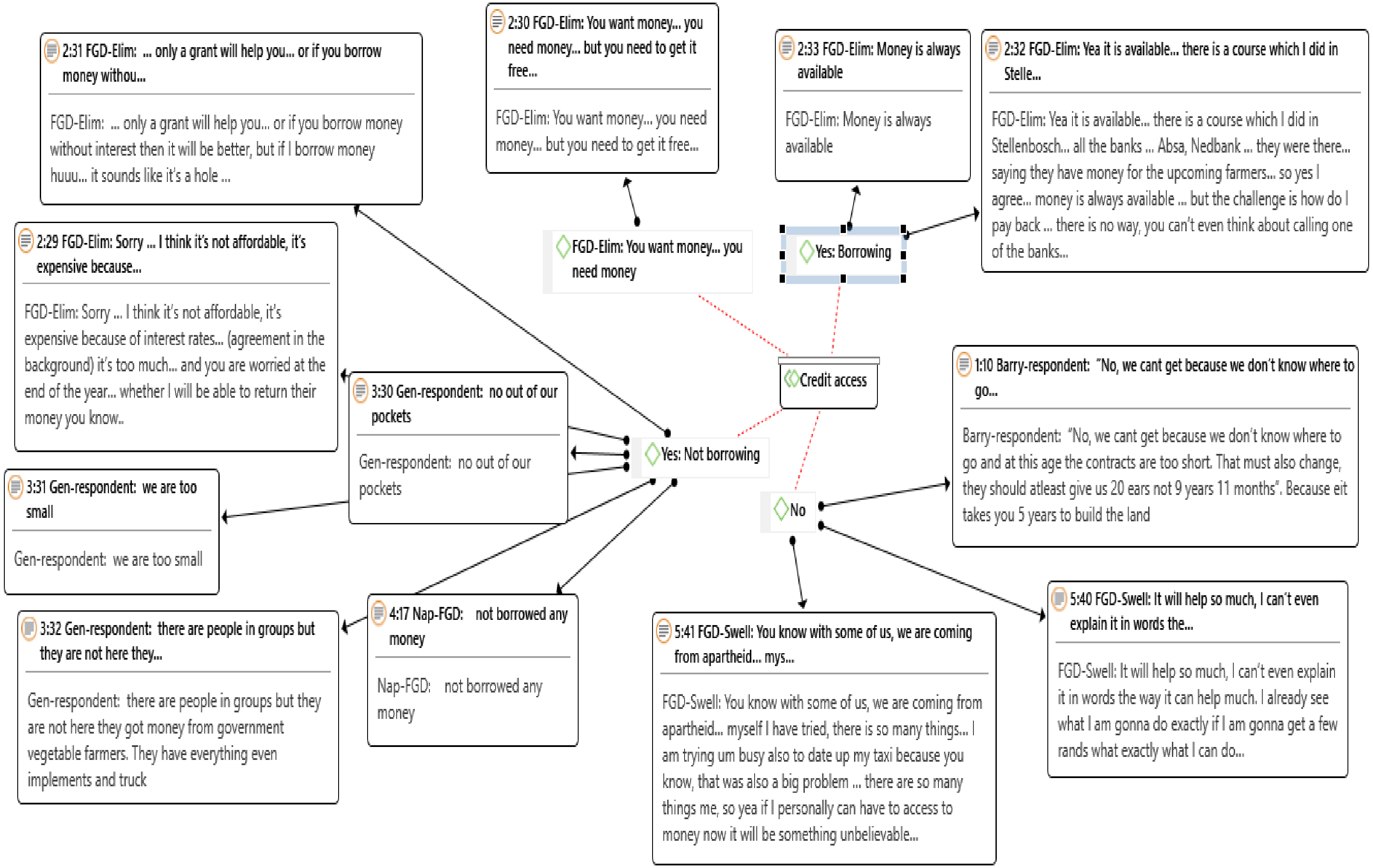

Figure 19: Focus group discussion on credit access in the Overberg district

(Gen-Genadendal, Nap-FGD- stands for Napier focus group discussion, FGD-SWELL- stands for focus group discussion Swellendam, Barry- stands for Barrydale, FGD-ELIM- focus group discussion Elim)

In the OD, SHFs who had access to funds in theory but were not borrowing mentioned that they were still very small and could not afford interest rates. In addition, SHFs indicated that it would be better if they received the money in the form of a grant. Farmers in Elim even said, “You need money…you need money... but you need to get it for free….”

4.14. Water and land resources

This section focuses on land and water resources, especially coping and adaptation strategies for agricultural water use and factors hindering the adoption of such strategies. In agriculture, water and land are the most important primary resources for agricultural production (FAO, 2017). Data on farm sizes showed that smallholder farmers occupy land, which so varies in size that generalisation is impossible. In WCD farm sizes ranged between 60x30m² to 6088ha and in the OD from 0.5ha to 2025.3ha, results are shown in Table 1.

Table 1: Smallholder farmers land sizes

Lad size	**West Coast District**	**Overberg District**
<1 ha	30%	8%
1-20 ha	38%	38%
21-40 ha	0%	6%
41-60 ha	0%	4%
81-100 ha	2%	4%
>100 ha	30%	40%

Smallholder farmers in the Overberg District (OD) were mainly farming on land between 1-20 ha (38%) and land above 100 ha (40%). While in the West Coast District (WCD) farmers were mainly farming on land less between 1-20 ha (38%) and on land greater than 100 ha (30%). Also, a large percentage of about 30% were farmers farming on land less than a hectare, this percentage is more compared to farmers in OD farming on land less than a hectare. About 66% of smallholder farmers were satisfied with the size of their farm, while the remaining 34% thought that their farms were too small. These were mainly farmers with less than a hectare of land. Insufficient land availability, therefore, remains a challenge for SHFs. According to Khapayi and Celliers (2016), limited farmland hinders the expansion of production and has negative implications for sustainability and income. In the study conducted by Abdul-Razak and Kruse (2017) in Ghana, an expert for livelihoods said that landholding size is critical to expanding crop productivity. Having sufficient land encourages smallholder farmers to participate in commercial markets. Some smallholder farmers who were satisfied with their land said that they enjoyed farming on a small scale because it was what they could handle. Smallholder farmers in the OD had smaller farms than smallholder farmers in the WCD.

Farmers farming in large farms are said to perform better against changes in climate than farmers on small farms (Abdul-Razak & Kruse, 2017; Leonardo et al., 2018).

4.15. Amount of land cultivated by smallholder farmers

Smallholder farmers were asked how much land they cultivated in relation to the land occupied. Two categories were devised as follows: Category 1, cultivate all the land; and Category 2, cultivate part of the land. The results are shown in Table 2.

Table 2: Amount of the land cultivated by smallholder farmers

Amount of land cultivated	**West Coast District**	**Overberg District**
Cultivate all the land	70%	68%
Cultivate portion of the land	30%	30%

Results show that about 70% of SHFs in the WCD and 68% in the OD cultivated all the land either by planting, grazing livestock or for livestock houses. Only about 30% in the WCD and 30% in the OD cultivated a lesser proportion of the land. Cultivating all the land showed commitment among smallholder farmers and a passion to invest as much time and resources in the land as possible. Among the farmers who cultivated a portion of the land were farmers who indicated that before the drought, they used to cultivate all the land, but because of agricultural water shortages, they now manage to cultivate only a portion. This was evident in that only 50% of onions and 80% of potatoes customarily planted were planted because of the drought (Zwane, 2019). Also, among smallholder farmers who cultivated a portion of their land was one farmer from Elim who could only cultivate 137ha of land out of 1325.5ha due to poor soil. According to Brown et al. (2010), in the WCD smallholder farmers have limited access to the land of good quality. According to WDM (2017), the land found in the WCD has soil with poor nutrient content.

4.16. Land ownership

Farming on their land encourages farmers to invest more in improving the land (Holden & Otsuka, 2014). Smallholder farmers were asked about their land tenure. The results are presented in Figure 20.

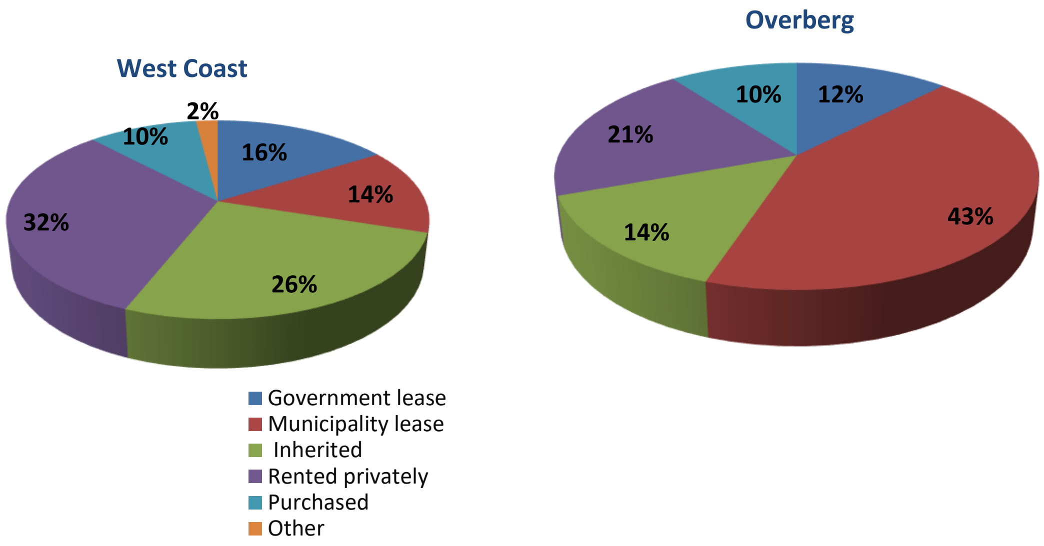

Figure 20: Land ownership among smallholder farmers

In the WCD, farming on rented land (32%) and on inherited land (26%) were the principal modes of land occupancy. This differs in the OD, where smallholder farmers were mainly farming on municipal land (43%) and on privately rented land (21%). Farming on land, which they had purchased themselves, encourages smallholder farmers to adopt drought strategies more zealously (Nabikolo et al., 2012). Only about 10% of SHFs in both the WCD and in the OD were farming on purchased land. Rusinamhodzi et al. (2016) found similar results where about 14% of smallholder farmers utilized purchased or borrowed land and the farmers mostly underutilized the land. For those in need of the land, the underutilized land was freely accessible to the community as grazing land (Rusinamhodzi et al. (2016). In contrast, the smallholder farmers in this study who had limited land usually utilized all the land when there was no drought.

Smallholder farmers farming on municipal land had lease agreements that differed in duration, from 4 to 30 years (the respondents were not required to specify). Nevertheless, farmers indicated that a lease of fewer than 10 years is a challenge because the process of preparing and cultivating the land can take up to 6 years before a profit is made. Short lease agreements have always been a problem for smallholder farmers, making them less productive and inclined to invest less in the land. Short-term leases discourage SHFs from making the best use of the occupied land (Ncube, 2018). Similarly, a study by Alam (2015) revealed that the security of land tenure has a positive impact on the adoption of adaptation strategies. Amadhila (2016) adds that short or no secure land tenure hindered smallholder farmers to obtain credit in Namibia.

About 66% of all the farmers interviewed indicated they needed more land to be fully productive. Smallholder farmers in the WCD tried to secure more land from 8 organisations, namely: the municipality (28%), local neighbours and organisations (22%), Communal Property Association (CPA) (17%), Rural Development (11%), church (6%), private owners (6%), Land Bank (6%) and Western Cape Department of Agriculture (6%). Farmers were most successful in securing land from the municipality and locally. Some farmers indicated that they had applied and were still waiting for a decision.

Smallholder farmers in the OD tried to secure more land from 6 organisations, namely, the municipality (38%), local neighbours and organisations (27%), private owners (14%), Rural Development (14%), Land Reform (5%) and from the church (3%). In both districts, SHFs mostly secured additional land from the municipality and locally. One farmer indicated that it was very expensive to rent land from private owners, such that he could not take up the offer of R10 000/ha. Carte et al. (2019) say that SHFs typically struggle to acquire land and usually prefer to rent land locally, monthly or yearly depending on the owner of the land. This is generally done by verbal agreement, with no formal process or contract (Mothae, 2017). More smallholder farmers in the OD were seeking additional land than in the WCD, which may be attributed to the larger farm sizes in the WCD.

4.17. Facilities owned

Smallholder farmers were asked if they owned any other agriculture-related facilities, with three options provided (storage facility, labourers' houses, and livestock houses). About 32% of smallholder farmers in the WCD owned agricultural related facilities, as against 54% in the OD. The results are presented in Table 3.

Table 3: Agricultural related facilities

Facilities owned	West Coast District	Overberg District
Labour houses	6	8
Livestock houses	1	9
Storage houses	9	10

The results show that few SHFs owned agricultural facilities in either district. This implies that smallholder farmers struggle to store, e.g., excess feeds, because of the absence of storage facilities. Findings by Williams et al. (2019) in Ghana show that inadequate storage facilities were the major constraint on smallholder farmers in successfully adapting to climate variability.

4.18. Water sources

Smallholder farmers get their water for agricultural use from various sources. The results of the responses to this question are presented in Figure 21.

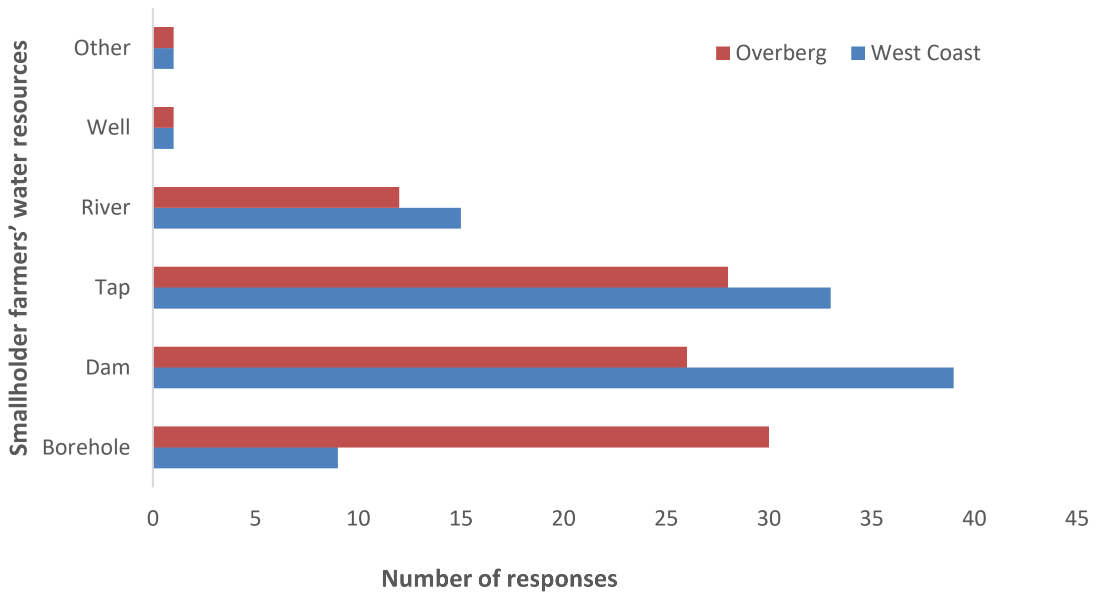

Figure 21: Smallholder farmers' water resources

Smallholder farmers in the WCD depended on the dam and the tap as the main sources of agricultural water. This is attributable to the presence of the Clanwilliam Dam that contributes to supplies of irrigation water and is said to provide about 700 farmers who irrigate about 16 000ha of land.

The dam also provides water to towns that include Vredendal (Western Cape Government, 2017). Taps were also a major source of water in the region, which in times of drought became problematic owing to water restrictions imposed by the municipality. A 60% cut in water allocation made farmers clamour for relief. Farmers complained that a 60% cut in water supply over a long period was sustainable, to the extent that farmers who grow tomatoes and potatoes could not plant anything (Gosling, 2018). Thus, water restrictions negatively affected smallholder farmers' production and livelihoods (FAO, 2017).

In the OD, boreholes, taps and the dam were the main sources of agricultural water. The utilisation of borehole water in the OD was common compared to the WCD. The utilisation of groundwater for agricultural purposes has increased significantly since the mid-twentieth century (FAO, 2017). Smallholder farmers utilising tap water in Darling did not have water during the 2015-2018 droughts since the municipality simply cut off their supply.

They only survived by drawing water from an old borehole drilled by Department of Water Affairs. When dam levels and river flows declined because of prolonged drought, smallholder farmers relying on these sources also became vulnerable. SHFs utilising borehole water can reduce the impacts of drought and survive (Mthembu & Zwane, 2017). Also, in Gauteng province, residents were encouraged to use borehole water to ease the 2015-2018 drought impacts (Troskie & Johnstone, 2016). To access water from these several sources, smallholder farmers needed water authorisation. SHFs were asked what authorisation they possessed to access water, with four options provided. The results for the WCD and OD, respectively, were General Authorisation (18%; 23%), Municipality (33%; 42%), Water Rights (44%; 28%) and Other (5%; 7%). Farmers in the WCD mainly accessed water through water rights and the municipality. The situation in the OD was the same, with the weighting reversed.

4.19. Water Infrastructure

To transport water from the sources to their farms, smallholder farmers used various forms of infrastructure. SHFs mainly made use of pipelines: 47% and 43% in the WCD and OD, respectively. Other infrastructure and water use methods in the WCD included canals (14%), flood irrigation (13%), water pumps (8%), drip irrigation (8%), and stock water system (4%). There were also smallholder farmers who had no infrastructure who transported the water in containers using a bakkie and even a wheelbarrow (4%). These accounted for 20% of respondents in the OD. For example, in the WCD farmer DAR44SWC mentioned that he used his car to transport water to the farm while farmer DAR42SWC mentioned that he hired transport, and if he had no money, he used a wheelbarrow.

In the OD, smallholder farmer ELI05O had to travel about 18km to get water from his cousin. In the OD, other infrastructure included water pumps (21%) and drip irrigation (2%). The results showed that smallholder farmers relied mainly on pipelines to transport their water, sometimes in conjunction with water pumps. However, smallholder farmers in the Lambertsbaai area pointed out that the pipeline on which they depended was narrow and exposed to the sun. Some farmers did not get water because the pressure in the pipeline is very low. The use of irrigation systems such as sprinklers was not common among smallholder farmers. Low-pressure drip irrigation is highly recommended especially when combined with rainwater harvesting; it can result in improved crops, higher yields and water conservation (Rockström et al., 2002; Namara et al., 2010). Having access to irrigation infrastructure help farmers to adapt better to drought than those with no access (Egyir et al., 2015).

4.20. Drought information and agricultural water drought strategies

4.20.1. The general perception of drought and its impacts

Smallholder farmers were asked how they perceived drought. They responded to the open-ended question: "On your understanding what is a drought?" The results are presented in Figure 22.

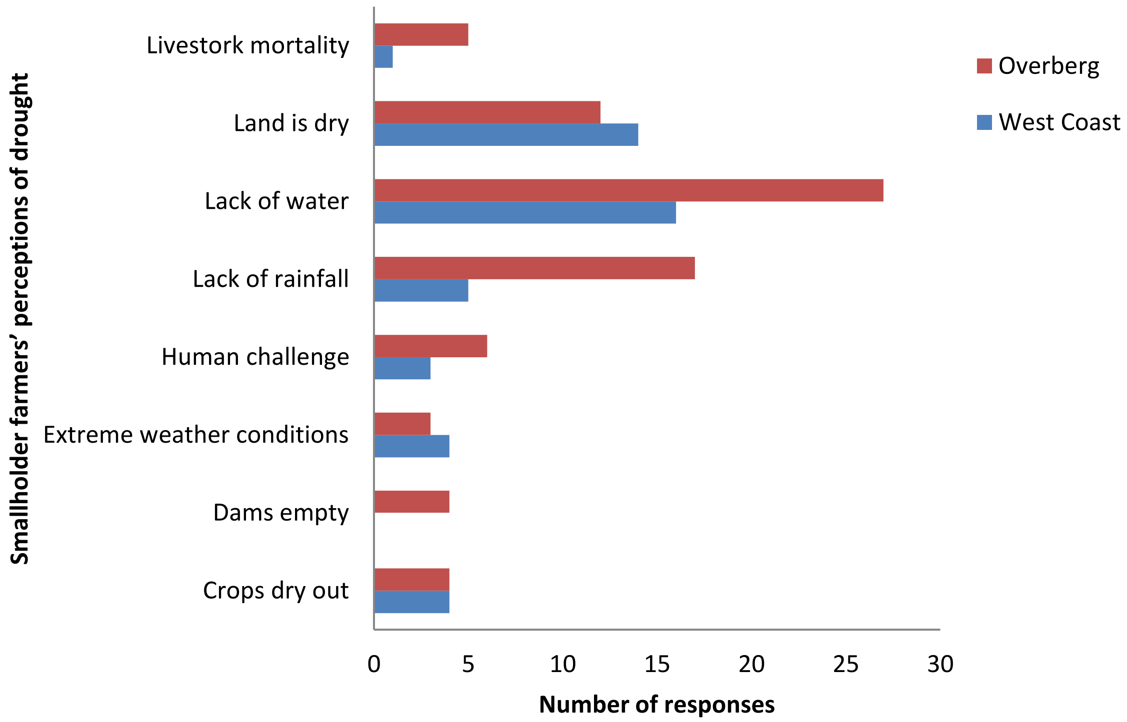

Figure 22: Smallholder farmers' perceptions of drought

The results showed that smallholder farmers in both districts commonly understood drought as a lack of water and rainfall, especially in the OD. Other aspects of drought that were mentioned included no feed for livestock, slow crop production, crop failure, bad livestock condition, and livestock mortality. Udmale et al. (2015) reported similar results in India, with farmers perceiving drought mainly in terms of a lack of agricultural and drinking water. In addition, there was an understanding of drought in terms of the dryness of the land owing to a lack of rainfall. Thurlow et al. (2007) say that all the efforts made by smallholder farmers to reduce poverty and food insecurity are undermined by the absence of rain and lack of water due to drought. Another drought perception by the farmers was that drought is a human challenge as well as a set of extreme weather conditions.

Smallholder farmers were asked if they had experienced droughts in previous years. The results are shown in Table 4:

Table 4: Droughts experienced by smallholder farmers

No. of droughts experienced	*West Coast*	*Overberg*
None	1 (2%)	*6 (12%)*
1-3 droughts	35 (82%)	37 (76%)
4-6 droughts	7 (16%)	6 (12%)

Percentage (%)- rounded off to the next decimal

Most smallholder farmers had experienced between 1 and 3 droughts. This tells us that drought was not a new phenomenon for most smallholder farmers. Only about 2% of smallholder farmers in the WCD and 12% in the OD had never experienced drought, and they were smallholder farmers who had recently started farming. About 16% of smallholder farmers in the WCD and 12% in the OD had experienced 4-6 droughts, and they were mainly elderly farmers.

4.20.2. Drought impacts

In the WCD 84% of smallholder farmers were impacted by the drought and 16% were not. In the OD 100% of respondents were impacted. Smallholder farmers reported severe impacts caused by the 2015-2018 drought. The results are shown in Figure 23:

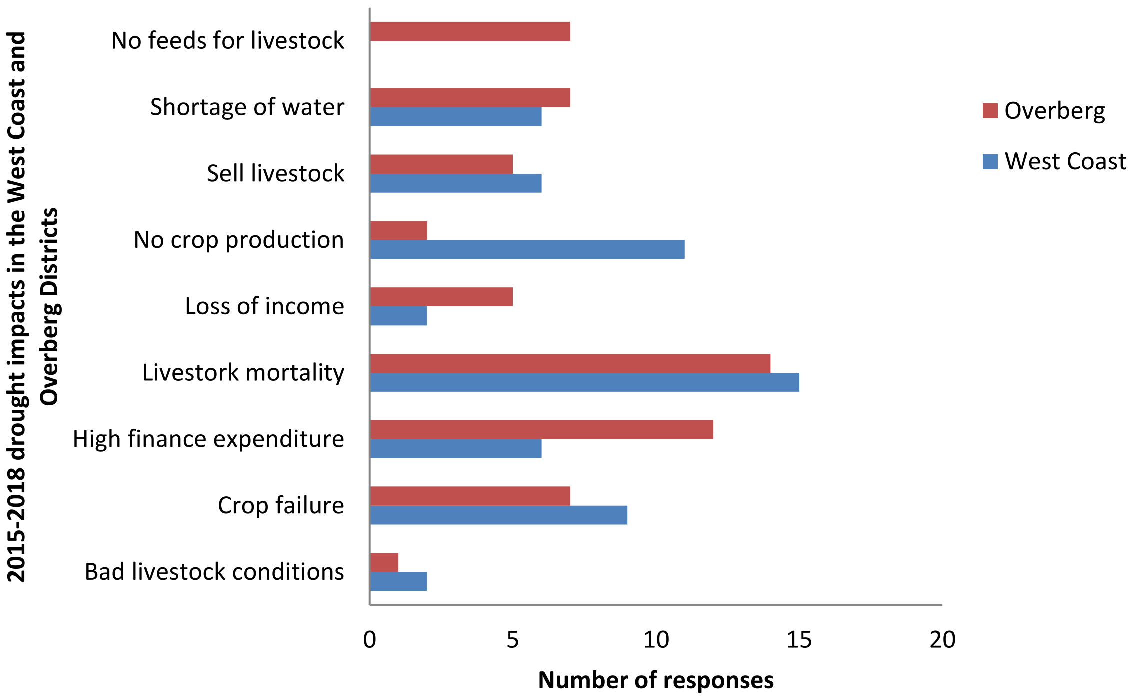

Figure 23: 2015-2018 drought impacts in the West Coast and Overberg Districts

Smallholder farmers are always hard-hit during a drought (Mukheibir, 2007; Jordaan et al., 2013; Opiyo et al*.,* 2017), and this study confirms the previous findings.

Both crop and livestock smallholder farmers were hard hit by the drought. Livestock farmers experienced extensive livestock mortalities in both districts. Some livestock were in such a bad condition because of a lack of water that smallholder farmers were forced to sell them at low prices to avoid more losses. Udmale et al. (2015) noted that during drought periods, livestock farmers suffered from shortages of fodder and water. Farmer ***GOE40SWC*** in WCD lost 12 cows and more than 10 sheep. Farmer ***VRE19NWC*** mentioned that sheep died while giving birth because of hunger and thirst, leaving their lambs behind. Similar impacts were experienced during the 2009-2011 drought in the Eden and Central Karoo Districts of the WC (Holloway et al*.,* 2012). Schreiner et al. (2018) findings attest that the 2015-2018 drought caused livestock mortalities due to scarcity of natural grazing.

As a result of drought crop farmers in both districts could not grow crops. For example, ***EBE04NWS*** reported that he could not further plant anything and was left with only enough water for one month. In addition, the farmer mentioned that he planted 200-400 tons of tomatoes for Syngenta, but only managed to reap 14% of the allocation. Farmer ***GOE32SWC*** lost his crop of beans because they dried up due to the lack of water for irrigation. In the OD, smallholder farmer ***AR01O*** said "*Normally I harvest 300 big bales and 3000 small bales. But in 2017 I harvested only 100 small bales and 20 big bales,"* while farmer ***LI06O*** remarked*: "I never talked about loss. But I planted 600 cauliflowers only 2 were successful"*. Smallholder farmers in the OD reported that there was no feed for livestock in the region because it was so dry. They could not grow fodder on their fields so they were forced to purchase extra fodder from a local co-op and elsewhere. Farmers in the OD spent more money than their counterparts in the WCD because they did not receive drought relief. They had to pay for fodder and medicine for their livestock as well as water. But in the WCD, too, farmers spent a lot on purchasing water and feed, as these two responses attest: ***VRE20NWC:*** *"I paid R900 for 700L*"; ***DAR50SWC:*** *"Have to spend money on buying feeds for livestock."*

Farmers were hard-pressed as a result of the additional expenditure incurred. Figure 24 shows responses from focus group discussion [FGD] for WCD farmers.

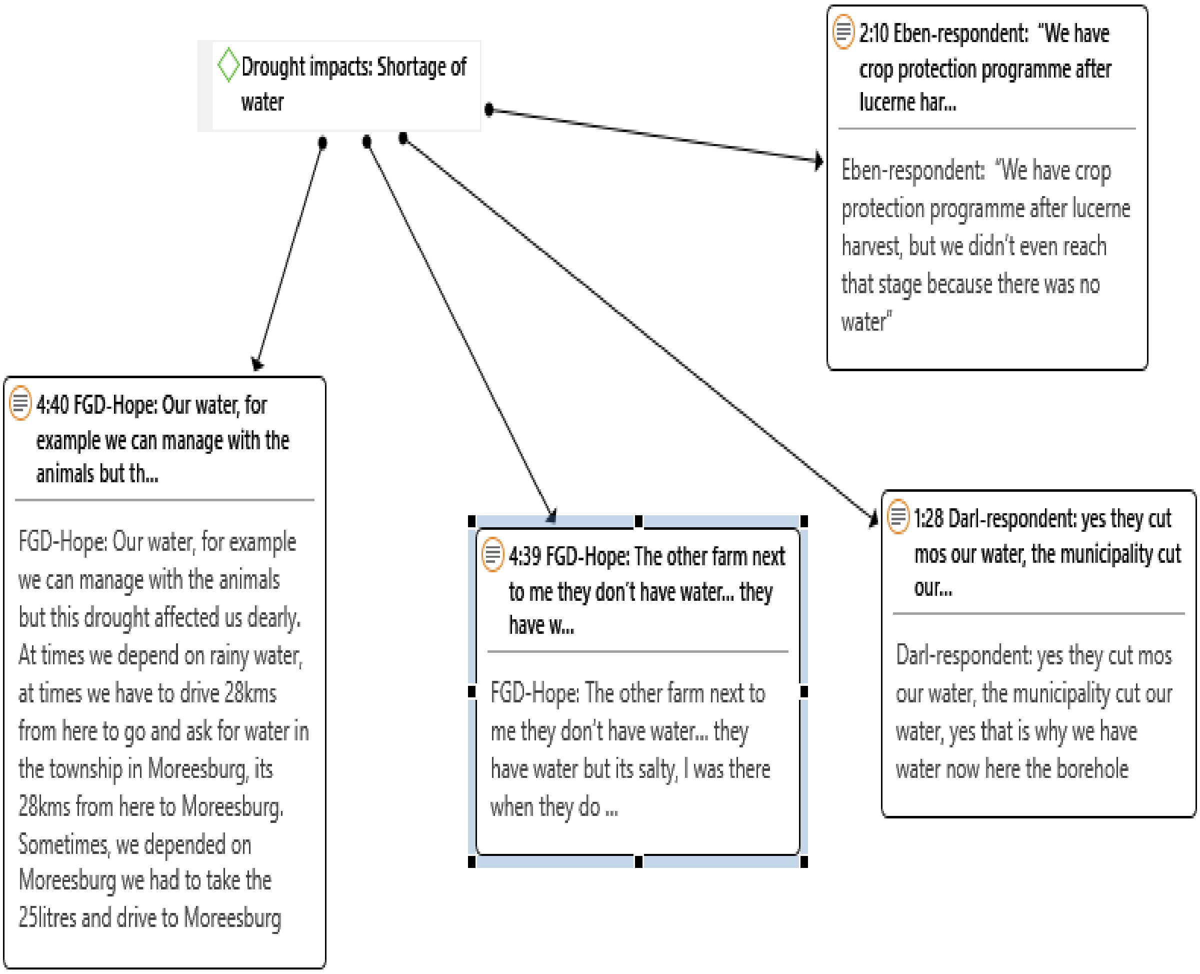

Figure 24: Shortages of water in the West Coast district as a result of the drought
(FGD-Hope- stands for focus group discussion Hopefield, Darl- Darling, Eben- stands for Ebenhaezer)

During the drought period, there were severe water restrictions and SHFs were directly affected. As one SHF remarked (SWE38O): "Water availability was restricted during the drought". Figure 25 shows results from focus group discussions on the shortages of water caused by the 2015-2018 drought in the Overberg district.

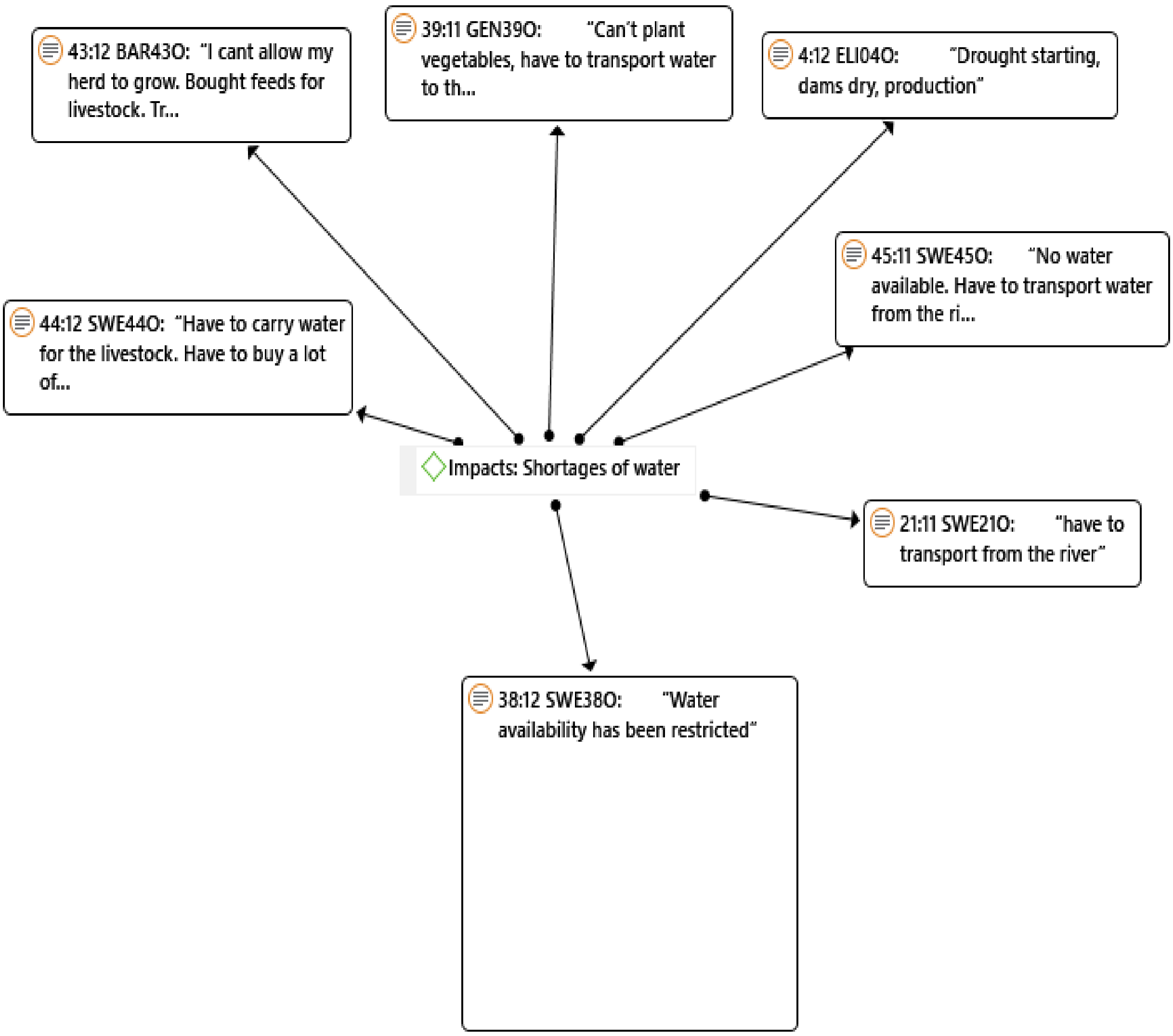

Figure 25: Shortages of water in the Overberg district as a result of the drought
***(Towns:** SWE- Swellendam, GEN- Genadendal, BAR- Barrydale, ELI- Elim. **District:** O- Overberg)*

Similar drought impacts as those found in this study were observed in other parts of the country. In the year 2015, the Illovo Sugar Company closed its Umzimkulu mill because of drought (Ntuli et al., 2015). In the Free State, because of drought, much of the land was left fallow (Vogel & Van Zyl, 2016). Moreover, even though SHFs were arguably hit hardest by the drought, in the Eastern Cape province one commercial cattle farmer took his own life because he could not cope during the drought. It was evident that the recent drought has had an impact on both commercial farmers' and smallholders' farming sectors, resulting in severe decreases in growth and productivity (Chabalala, 2016; AgriSA, 2016; Zwane, 2019).

4.20.3. Coping Strategies

SHFs were asked how they managed to survive for the short term during the drought. Their responses are shown in Figure 26.

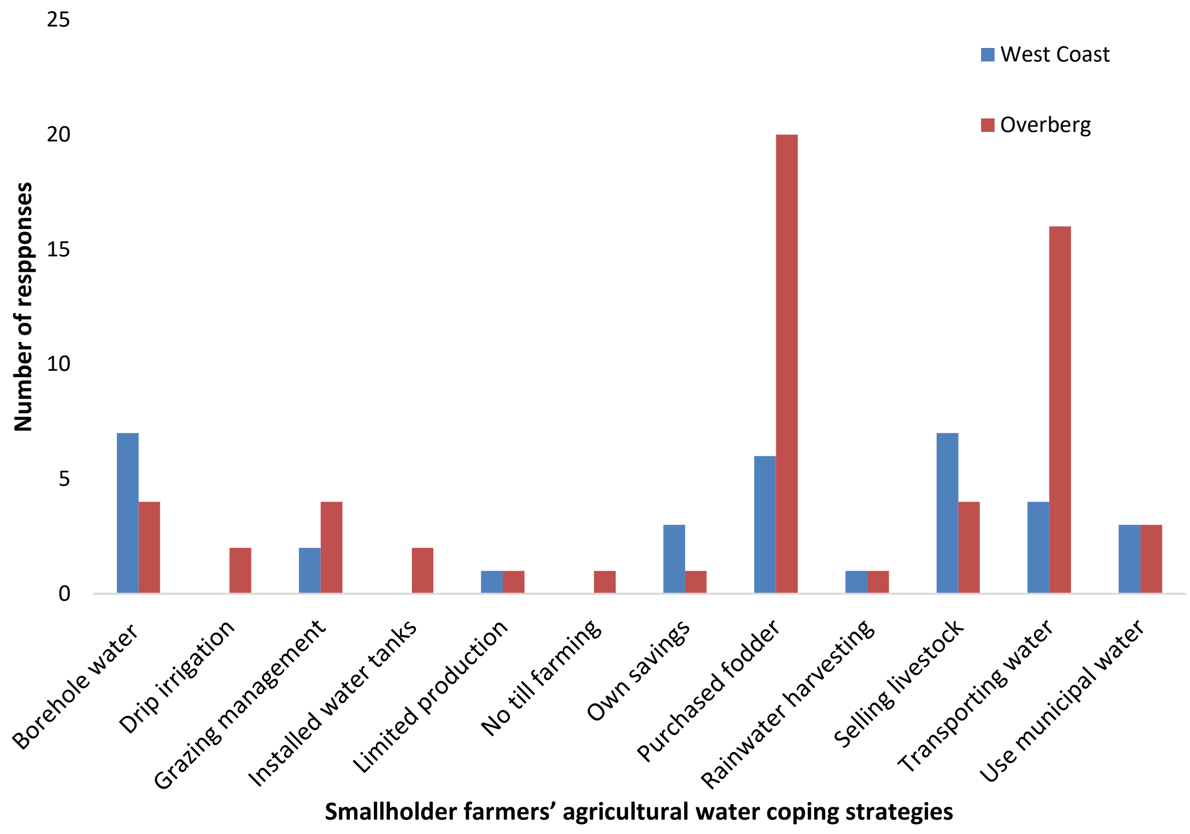

Figure 26: Smallholder farmers' agricultural water coping strategies

In the WCD, SHFs coped with the drought by utilising borehole water (21%), purchasing fodder (18%) and selling livestock (21%). Strategies such as grazing management (6%), limiting production (3%) and rainwater harvesting (3%) were not commonly adopted. In the OD, SHFs mainly coped with drought through purchasing fodder (34%): they had no option but to spend their money to maintain their livestock herd and prevent more loss. If other agricultural water strategies could be made known to SHFs, they would have more and possibly less expensive, options to choose from (Kumari et al., 2014; Phuong et al., 2018). SHFs also coped by fetching water from rivers or dams. Hornby et al. (2016) made similar findings in Limpopo, where farmers carried water from the source to the livestock on the farm during the drought. Mukheibir (2007) argues that such a strategy is reactive and SHFs should not rely on it, for when the rivers or dams dry out in severe drought, SHFs should be able to continue production. Hence, there is a need to adopt proactive agricultural water use strategies that will reduce drought impacts and vulnerability. This will also help to create more drought resilient farmers and ensure food security (Wilhite, 2019; Bandyopadhyay et al., 2020). Other coping strategies included borehole water (7%), grazing management (7%), selling livestock (7%) and using municipal water. Ngaka (2012) said that reducing a livestock herd is one of the key strategies for reducing the potential impact of drought. Ndlovu (2019) concurs that this helps to maintain herd size with available feeds. However, smallholder farmers complained about the high cost of restocking after the drought.

Strategies such as drip irrigation (3%), no-till farming (2%), limiting production (2%) and rainwater harvesting (2%) were not commonly adopted by SHFs. Yet these strategies are seen as proactive and can help SHFs to minimise drought impacts (Deressa et al., 2011; Uddin et al., 2014; Ncube, 2017; Vilakazi, 2017). This tells us that farmers are not well informed about possible proactive agricultural water use strategies that can build their resilience towards drought.

SHFs are known to be uninformed of or unprepared for agricultural water use strategies and rely mostly on drought relief schemes (Ngaka, 2012). Mthembu and Zwane (2017) add that smallholder depends on drought relief support such that if the relief is delayed or not provided, farmers are left with constrained or no alternatives to sustain their production. Drought relief only caters for immediate needs and has no impact on long-term purposes and in building farmers' resistance to future droughts (Ngaka, 2012; Khumalo, 2019). Nevertheless, there are various departments for funding support programmes for smallholder farmers. These include the Department of Agriculture, Forestry and Fisheries (DAFF) that offer funds through grants, the Department of Rural Development and Land Reform (DRDLR) that funds through direct programmes as well as the provincial equitable share (PES) from National Treasury to provincial treasuries (African Centre for Biodiversity, 2018). Gerber and Mirzabaev (2017) discourage reliance on drought relief and urge the adoption of proactive strategies that improve resilience. Drought relief encourages farmers to become reliant on government support while continuing to be generally under-equipped (Ngaka, 2012). For instance, programmes such as CASP are intended to provide training and capacity building, to provide farm infrastructure and necessary inputs and financial support. This is to enhance smallholder farmers’ farming efficiency and transform smallholder farmers into commercial farmers (Xaba and Dlamini, 2015). However, smallholder farmers from both districts were still dependent and mainly supported by drought relief. Bhebe (2014) argues that, drought relief cause smallholder farmers to be more vulnerable in the face of recurrent droughts, and they are not equipped to respond to drought and how to cushion against drought. As a farmer in the EC province pointed out, receiving help from the government is good; but the government should equip farmers to survive on their own during drought periods (Ngaka, 2012).

Proactive agricultural water use in cropping includes zero or minimum tillage, as this helps to conserve moisture in the soil and less water will be required for irrigation and ensures that the soil is less prone to erosion and effectively retains water and nutrients (WWF, 2010; Ncube, 2017). Mulching also helps reduce evaporation and retain water in the soil during droughts (CUESA, 2014; Ashoori et al., 2016; Ncube, 2017). Flood irrigation at night slows down evaporation allowing water to seep down into the soil and refill the water table (CUESA, 2014; Falco & Veronesi, 2014). Other strategies include constructing spreader banks to conserve moisture in grazing lands, rotational grazing, sharing of grazing resources, adopting ecological principles to maintain grazing lands, and managing livestock units according to the carrying capacity of the grazing lands (Ncube, 2017; Ncube 2018; Ndlovu, 2019).

4.20.4. Adaptation strategies

For some time, dealing with drought has always focused on short-term mitigation strategies rather than on long-term prevention strategies. Recently, new approaches have been implemented that shift away from drought risk management but promote preparedness, help prevention, and enable planning to adapt to drought (FAO, 2004; Tadesse, 2018). Smallholder farmers were asked if they had put any agricultural water use adaptation strategies in place before the drought came. About 68% and 64% in WCD and OD, respectively, had not put in place any strategies. Only 32% of SHFs in the WCD and 34% SHFs in the OD had adopted adaptation strategies. The results are shown in Table 5.

Table 5: Agricultural water use drought adaptation strategies implemented by smallholder farmer

West Coast	Overberg
Stored fodder **(3)**	Stored fodder **(7)**
Installed water tanks **(2)**	Rainwater harvesting **(4)**
Rainwater harvesting **(1)**	Moved livestock to secure areas **(1)**
Moved livestock to secure areas **(1)**	Insurance (**2)**
Limited production **(1)**	Conservation farming **(1)**
Used limited water **(1)**	Alien clearance **(2)**
Adjusted livestock herd **(1)**	Savings **(2)**
	Sold livestock **(1)**
	Drilled borehole **(3)**

*(**n**)= number of responses per adaptation strategy cited, Overberg (n=23), West Coast (n=10)*

Among farmers in the WCD, agricultural water use adaptation strategies included storing feeds (7%), planting their livestock fodder (5%) and installing water tanks (5%). Storing feeds has always been seen as a proactive strategy for adaptation purposes since it makes provision for stock feed during drought periods when farmers cannot grow their fodder (Rothauge, 2001; Ndlovu, 2019). Other strategies included rainwater harvesting, using less water, limiting crop production and purchasing feeds. In the OD, adaptation strategies included storing livestock fodder (13%), storing water (5%), drilling boreholes (5%), saving money (4%), purchasing fodder (4%) and paying insurance (4%). Strategies such as conservation farming, alien plant clearance, moving livestock to secure areas, selling livestock, rainwater harvesting and installing water tanks were not widely implemented by SHFs. Rainwater harvesting in drought-prone areas is encouraged as it likely to reduce water shortages when adopted on a large scale (Sharma & Smakhtin, 2016). Taking out insurance is a useful option, as it can serve as a cash cushion to help farmers during drought periods to cope, adapt better, and recover from unforeseen impacts (Kahan, 2013), but farmers in the study did not have insurance because farming is generating little income. Greatrex et al. (2015) argues that during disasters agricultural insurance provide finances to help farmers to cope and maintain their livelihoods. Mutaqin and Usam (2019) say that smallholder farmers are hindered by multiple factors not to have insurance. One of the main factors is that the insurance premium is generally high and not affordable for smallholder farmers. This might be the case in this study since farmers mentioned that income received is not enough such that it cannot be distributed to accommodate all farming needs.

The results showed that a large number of SHFs had implemented no agricultural water use drought adaptation strategies. Even some of the adaptation strategies mentioned were not adopted. This tells us that SHFs have limited options on the subject of possible agricultural water use adaptation strategies. Adaptation strategies cited, such as selling livestock and purchasing fodder, are good as coping strategies but cannot be relied on for long-term and future purposes, especially as droughts are likely to become even more severe than at present (Nhamo et al., 2019). In Ethiopia farmers who were purchasing livestock feed as an adaptation strategy purchased much less feeds as the drought persisted because the purchase of feed for the entire year was becoming costly and unaffordable. But farmers who stored livestock feed were more likely to maintain available herd (Berhe et al., 2017).

Instead of selling their livestock farmers can alter their herd composition and add goats, which are drought resistant compared to sheep and cattle (O'Farrella et al., 2009; Opiyo et al., 2015). Berhe et al. (2017) result revealed that farmers who moved their livestock to areas with water and natural grazing achieved more income. There were no soil and water conservation or irrigation techniques adopted by farmers, yet other authors support such strategies for adaptation purposes (Faltermeier, 2007; Deressa et al*.,* 2011; Jara-Rojas et al., 2013; Uddin et al., 2014; Ashoori et al., 2016). These strategies include amending soils with livestock manure and covering the soil with crop residues and allow the land to remain fallow (Faltermeier, 2007; Jara-Rojas et al., 2013); constructing small ponds to capture and store rainfall water (CUESA, 2014); building spreader banks to conserve moisture in grazing lands; rotational grazing and managing one's livestock herd according to the carrying capacity of grazing lands (Ncube, 2018), plant drought-tolerant crops, changing planting dates and crop rotation, use of manure, and conservation tillage to reduce the likelihood of erosion to conserve water and maintains water-holding capacity (Ashoori et al., 2016; Harvey et al., 2018), water conservation by adopting irrigation techniques such as sprinkler and drip irrigation (Uddin et al., 2014; Harvey et al., 2018). Other soil conservation adaptation strategies include mulching (Jara-Rojas et al., 2013); ratoon cropping which helps to reduce the need for more irrigation (Ashoori et al., 2016).

It is clear that SHFs only implemented strategies known to them, not taking into consideration whether they would work in the short as well as long term. There is a need to equip SHFs with information on both coping and adaptation strategies that will build resilience towards future droughts and prevent reactive tactics and reliance on drought relief. The adaptability of SHFs to climatic events such as droughts is limited by several factors that include but not confined to a lack of access to financial facilities such as credit and grants (Turpie & Visser, 2013).

4.20.5. Factors hindering adoption of adaptation strategies

To achieve the third objective of the study, SHFs who had implemented no specific adaptation strategies were asked what had hindered them from doing so. Botai et al. (2017) noted that many adaptation strategies that might be adopted by farmers are associated with challenges that impede farmers from implementing them. The results from farmer responses in this study are shown in Figures 27 and 28.

The main factor that stopped farmers (about 80%) from adopting adaptation strategies was a sheer lack of drought awareness. Other factors included a lack of finance (7%), drought relief (3%), lack of water (3%), with one farmer conceding that they were not well equipped to adapt to drought (3%).

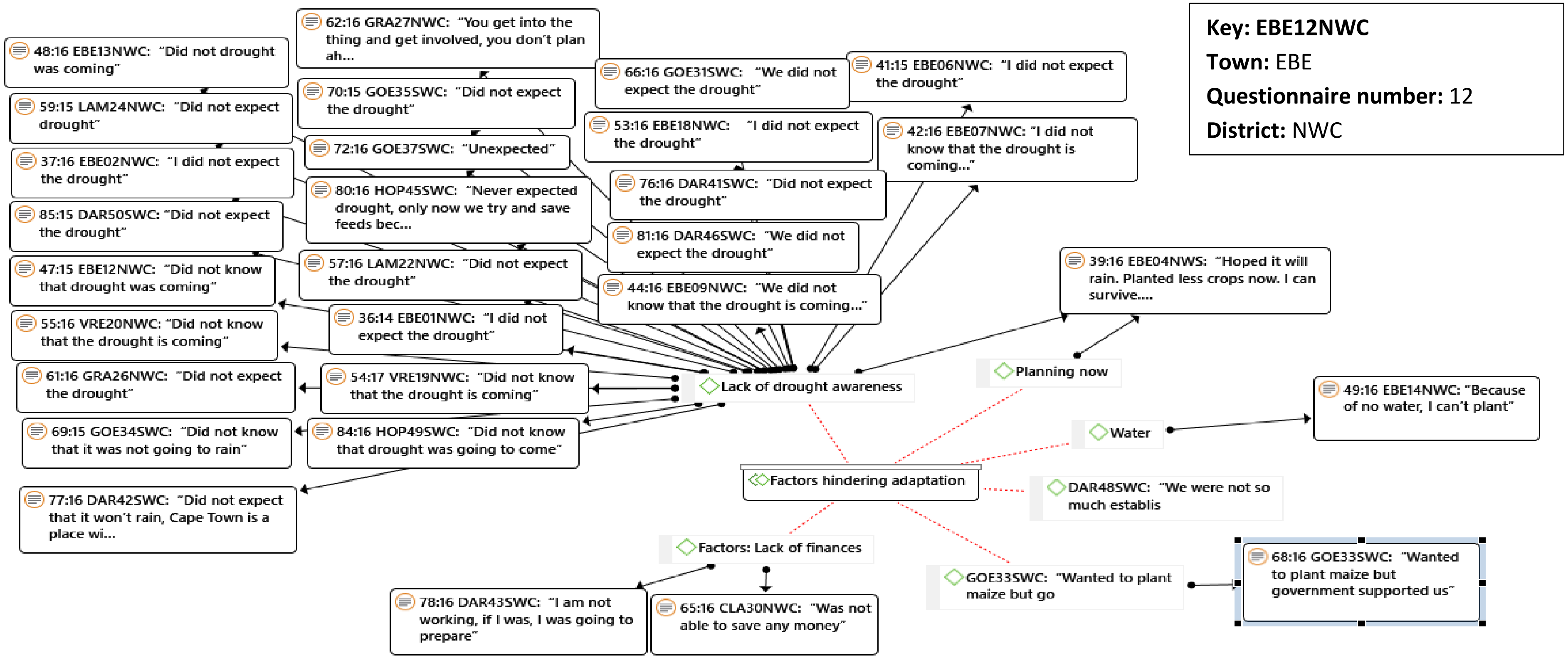

Figure 27: Factors hindering adoption of adaptation strategies in the West Coast district
*(**Towns:** DAR-Darling, EBE- Ebenhaezer, GOE-Goedverwacht, HOP-Hopefield, LAM-Lambertsbaai, GRA-Graafwater, VRE-Vredendal, CLA-Clanwilliam. **Districts:** NWC-North West Coast, SWC- South West Coast)*

Key: EBE12NWC
Town: EBE
Questionnaire number: 12
District: NWC

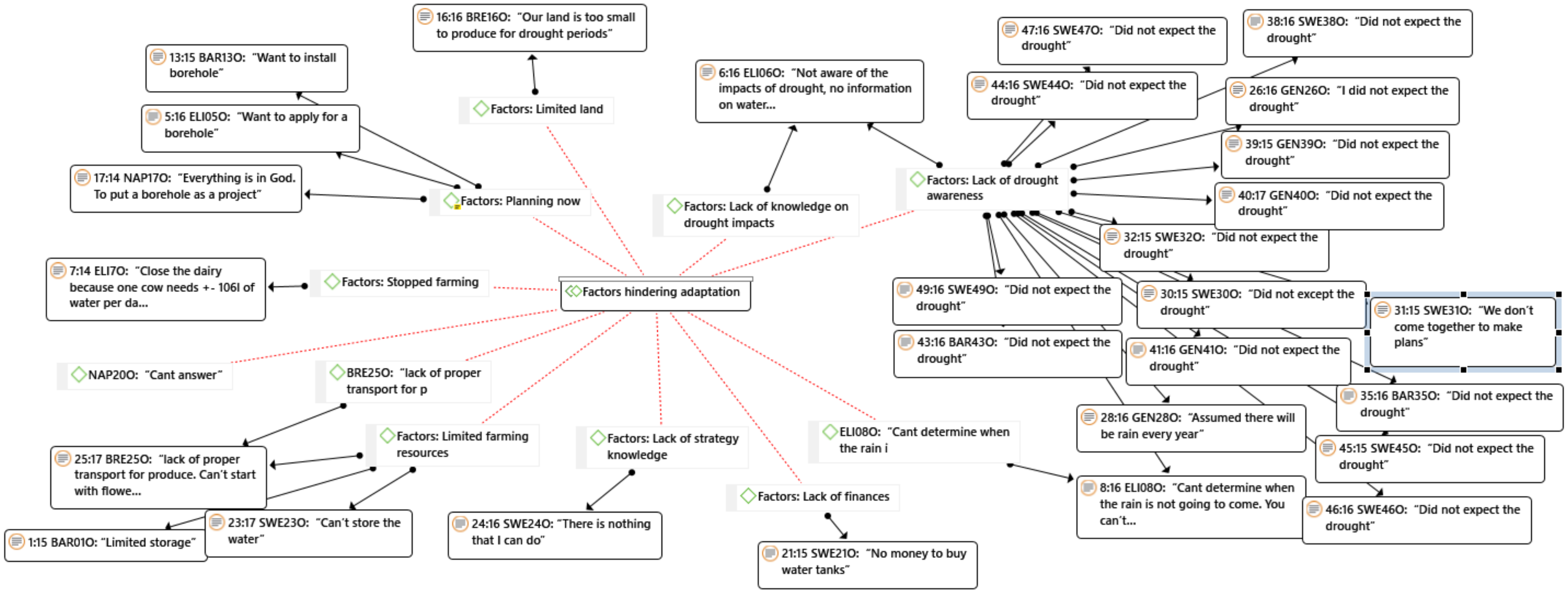

Figure 28: Factors hindering adoption of adaptation strategies in the Overberg district
(Towns: *SWE- Swellendam, GEN- Genadendal, BAR- Barrydale, ELI- Elim, NAP- Napier, SUU- Suurbraak.* ***District:*** *O- Overberg)*

Similar to the WCD, the main factor that hindered the adoption of adaption strategies in the OD was a lack of drought awareness (62%). Other factors included limited farming resources (10%), short-term planning (10%), lack of finances (3%), lack of knowledge about drought impacts and adaptation strategies (3%), and limited land (3%). One farmer mentioned that she decided to stop farming and hence attempted no adaptation strategies. The results showed that lack of drought awareness was the main factor that hindered adaptation among farmers. This implies that such Early Warning Systems (EWSs) as exist are not operating properly in the regions concerned. Similar findings were observed by Udmale et al. (2015) in India and Ubisi et al. (2017) in Limpopo where farmers did not adapt very well to climate change because of lack of information and awareness on climate change.

4.20.6. Drought support

To be able to cope and adapt to drought SHFs need financial support (Ndlovu, 2019). Respondents were asked if they had received any support during the 2015-2018 drought. About 92% and 56% of SHFs in the WCD and OD, respectively, received support during the drought. A follow-up question was asked about which organisations offered support. Table 6 shows results on organisations that provided support during the 2015-2018 drought.

Table 6: Organisations that provided support to smallholder farmers during the 2015-2018 drought

	West Coast	Overberg
Supporting organisations	Agri-SA (1) CASIDRA (2) DWS (1) WCDoA (31) Individuals (5)	Overberg Agri (2) CASIDRA (1) Agri-Dwala (1) WCDoA (5) Individuals (9) Co-operative (1) Viking (1)

*(**n**)= number of responses per organisation cited, Overberg (n=20), West Coast (n=40),*

Only 56% of SHFs received support in the OD, and only five of them received support from the government because the region was not declared a drought-prone region (Department of Local Government, 2017). However, all the respondents were affected by the drought in the region and experienced similar impacts to SHFs in areas declared disaster areas. The kinds of support offered to farmers in the affected districts are presented in Table 7.

Table 7: Support offered to smallholder farmers during the 2015-2018 drought

West Coast	Overberg
Advisory services (1)	Chemicals (1)
Drought relief (30)	Finances (1)
Implements (3)	Implements (4)
Livestock medicine (1)	Livestock medicine (2)
Seeds (1)	Seeds (1)
Water (1)	Water (3)

*(**n**)= number of responses per support cited, Overberg (n=13), West Coast (n=37),*

The provision of fodder for livestock was the main kind of support offered during the drought in the WCD, while in the OD no such drought relief was offered since the area was not declared a disaster area (Department of Local Government, 2017). Support relating to agricultural water use included the supply of water, implements such as water tanks, as well as funding for the purchase of extra water. As made clear above, drought relief does not promote the adoption of agricultural water strategies and does not build drought resilience among SHFs (Ngaka, 2012). Keshavarz et al. (2010) advise that to build resilience in SHFs, farming organisations or institutions supporting smallholder farmers should provide inputs necessary to enable farmers to reduce drought impacts and be better prepared for future drought conditions. This would include providing water storage facilities like tanks, to help farmers practise strategies like rainwater harvesting. Given that the decline in rainfall was predicted in 2013 to be 5.4% in 2020, 6.3% in 2050 and 9.5% in 2080 (Turpie & Visser, 2013), there is clearly a need for appropriate intervention by the government.

4.20.7. General challenges

SHFs face many challenges that increase their vulnerability to drought. The respondents were asked if they encountered any other challenges in their farming. In the WCD there were three main problems mentioned by SHFs: lack of farming resources and labour (16%), land (16%) and water (16%). Other issues included finance (10%), lack of support (7%), theft (7%) and the drought (7%). Some SHFs also mentioned social issues, wild animals and electricity. In the OD there were also three main challenges that SHFs cited: theft (16%), lack of farming resources (14%) and land (14%). Other challenges included finance (10%), water (9%) and social issues (5%). Some SHFs also cited infrastructure, group dynamics, health, markets, lack of skills, electricity, and age. The issue of land was common to farmers in both districts, as well as the paucity of farming resources. The issue of water was mainly raised in the WCD, while theft was more of a problem in the OD.

4.20.8. Comparison of the results to the Hyogo Framework of Action (HFA): 2005-2015

Table 8 shows five HFA principles and to achieve each principle there are goals associated therewith. The findings of the study were compared to the principles and goals of the HFA. This helped to give an insight into current gaps in drought knowledge, identify and observe the shortcomings in the methods employed by the smallholder farmers, key organisations supporting smallholder and the government in coping, adapting and building resilience towards drought. This framework helps to propose solutions for effective integration of disaster resilience (European Forum for Disaster Risk Reduction, 2014).

Table 8: Comparison of the study results with the Hyogo Framework of Action: 2005-2015

HFA Principles	**Goal**	**Objectives and Findings**
1. Ensure that disaster risk reduction is a local priority	-Knowledge about drought among farmers -Early warning: people-centered information system, data sharing	-Limited knowledge and understanding of drought -Drought reduction is not a priority among smallholder farmers, e.g. some farmers had no plans in place and took each day as it comes. -No drought information system for smallholder farmers
2. Identify disaster risks and enhance early warning	-Actions are taken on the basis of that knowledge **(Coping Strategies)**	-Few known coping strategies (twelve cited coping strategies) and rarely adopted by farmers - Known strategies were not commonly adopted by smallholder farmers
3. Use knowledge and education to build resilience	-Implementation of strategies to build resilience towards disaster **(Adaptation strategies)** -Information sharing and co-operation -Public awareness **(Early warnings)**	- A large percentage of smallholder farmers (about 68% in the West Coast and 64% in Overberg district) had not put in place any strategies. -Limited known adaptation strategies were not actually adopted -Strategies regarded as proactive in literature such as conservation farming, alien plant clearance, moving livestock to secure areas, rainwater harvesting and installing water tanks were not widely implemented - Smallholder farmers did not adapt very well to climate change because of lack of information and awareness on drought -Department of Agriculture offers training, however, there is a need for emphasis on drought - Lack of drought awareness was the main factor that hindered adaptation among farmers -Farmers are hindered by various other factors to adapt to drought (lack of finances, lack of knowledge on drought strategies) -Farmers group with limited to no drought discussions -Unreliable drought warning systems (late and unclear)
4. Reduce the underlying risk factors	-Recovery schemes and social safety-nets **(Support)** -Financial risk-sharing mechanisms **(Credit facilities)**	-Support was offered mainly to farmers in the West Coast a region that was declared disaster area under the Disaster Management Act -Smallholder farmers in the O -Drought relief was the main support provided for farmers -Support was not sufficient other farmers struggle to maintain their livestock -Smallholder farmers in Overberg received minimum to no support, but they experienced similar impacts as smallholder farmers in the West Coast District -About 84% of farmers had access to credit, but only a few were borrowing due to high credit interest - Some smallholder farmers revealed that they did not have ready access to the credit facilities and were not aware of who to contact -No safety nets for smallholder farmers -Smallholder farmers have no insurance because of low generated income
5. Strengthen disaster preparedness for effective response	-Farmers well equipped with the knowledge -Farmers well prepared and ready to act with capacities for effective drought management	-Smallholder farmers were unprepared for drought occurrence and to implement agricultural water-use strategies, and rely mostly on drought relief scheme -Farmers not well equipped with the knowledge and not ready to act -Low coping and adaptation capacities -Smallholder farmers are not equipped to respond to drought

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

This study examined smallholder farmer coping and adaption strategies to drought in the Overberg and West Coast districts. Factors that hinder the adoption of such strategies were also identified.

Smallholder farmers from both districts experienced severe losses in production, for both livestock and crop production. The results indicate a low coping and adaptation capacity among smallholder farmers in Overberg and West Coast Districts. SHFs were responding to the drought by employing coping strategies rather than adaptation strategies. Vulnerability to drought by smallholder farmers was mainly attributed to lack of drought knowledge, lack of preparedness, lack of robust coping and adaptation strategies and low coping and adaptive capacities. These challenges accentuated the vulnerability of SHFs in both studied districts.

There were few options for coping with drought and these included purchasing fodder, transporting water and selling livestock. Smallholder farmers rarely adopted effective adaptation strategies; about 68% of SHF in WCD and 64% in the OD had no plans in place. This implies the likelihood of continuing vulnerability to severe drought impacts in the future.

For smallholder farmers to be resilient towards drought, they need to reduce drought impacts as their daily priority as advised in the Hyogo Framework for Action (HFA) 2005-2015. This could be achieved by ensuring that SHFs are well educated and knowledgeable about drought and its associated impacts and encouraging them to reduce drought effects as a priority in their everyday activities. Because some SHFs admitted that they had no plans to respond to drought and took each day as it came. Other SHFs indicated that they were poor and felt that there was nothing they could do to minimise drought impacts; they wanted the government to help. There were no information systems in place ensuring that important and relevant information about drought occurrence was communicated clearly to smallholder farmers. These information-sharing systems could include early warning systems that are farmer-focused and spread relevant information. The development of drought early warning systems would help to enhance smallholder farmers' response and preparedness towards drought.

The SHFs were unaware of coping strategies recommended in the literature, such as the construction of spreader banks on grazing camps, the use of drought resistant crop varieties, or changing the dates of planting and irrigation times. Thus, owing to their limited knowledge of drought occurrence and strategies, SHFs had few options when it came to responding proactively.

There were networks among SHFs, but because of the paucity of shared knowledge, they were not of much help in fostering drought resilience. Although SHFs were attending different events ostensibly catering to their interests, there was a lack of drought-related training or workshops that could help them with coping with and adapting to drought. For instance, the Western Cape Department of Agriculture offered training and workshops for SHFs but needed to include an emphasis on drought, on how SHFs could adapt and build up their resistance to drought. There were few known adaptation strategies capable of doing this. These included the drilling of boreholes, farming with goats, rainwater harvesting and storing livestock fodder. However, only a limited number of farmers implemented them.

The results showed that some farmers could not implement adaptation strategies because of several factors, these included lack of drought awareness, with the onset of drought catching them unprepared. This implies that there were no early warning systems (EWSs) in the communities concerned, or if there were, that they were not operating properly. Effective EWSs play a significant role in providing timely and relevant information that farmers can use to minimise drought impacts by preparing and adopting proactive strategies. For example, in Darling in the WCD, the municipality shut off the water because of the drought when SHFs were not even aware of the occurrence of drought in the area

Even though a lack of knowledge of drought strategies was not the main factor identified by the SHFs as hindering adaptation, it was one of the main factors in both districts. SHFs were not aware of other possible adaptation strategies as recommended in the literature. This was confirmed during focus group discussions where SHFs were asked what they would had done differently if they were aware that the drought was coming. SHFs were only aware of a few options. Therefore, lack of drought adaptation strategies could perpetuate vulnerability to drought among smallholder farmers, with catastrophic consequences of poverty and food insecurity in both districts.

During the focus group discussions, water, limited land, the absence of funding, and limited farming resources were cited as hindrances impeding planning for the drought. Insufficient support and funding as well as adopting disaster response are likely to exacerbate the vulnerability of smallholder farmers because their farming is generating less income and they need additional funds to maintain their production. In addition, drought mitigation is still more response-based than risk-reduction-based, with farmers depending on government relief. However, not all the farmers received the drought relief and among those who did receive, they reported that it was not enough they had to use their money to survive the drought. There is also a need for financial reserves and contingency mechanisms in place that accommodate smallholder farmers. This would ease severe drought losses in SHF agricultural production in the future.

5.2. Recommendations

There were more men than women in this study. Also, older men were more involved in agriculture than the youth. Therefore, there is a need to encourage the youth to participate in agriculture, as this might threaten food security in the country in the future. This could be achieved if all organisations helping SHFs including CASP could invest in training and give agriculture-oriented education, to enhance agricultural productivity and ensure food security.

Mostly SHFs farm on leased land with various periods of tenure. SHFs with a lease agreement of fewer than 10 years complained that the given period was too short to be able to achieve something worthwhile. Therefore, there is a need to give farmers long-term lease agreements to encourage them to put more investment into the land and ensure its productivity.

Both livestock and crop SHFs experienced severe setbacks because of drought. The impacts of the drought are exacerbated by farmers' lack of knowledge of drought occurrence and strategies, lack of early drought awareness, and low coping and adaptive capacity. There is therefore a need to educate and equip SHFs to deal with drought occurrence and resort to appropriate coping and adaptation strategies as the Western Cape province remains one of the most disaster-prone provinces in South Africa. This could be achieved by ensuring that agricultural extension officers and other co-op officials knowledgeable about drought teach about the drought in regular smallholder farmers' events and offer training on drought strategies. There is also a clear need for proactive EWSs that provide timely and clear weather forecast information to smallholder to improve the drought preparedness and safeguard them from the worst ravages of drought. In addition, ongoing education and practical training can help to reduce SHFs' current and future drought vulnerability.

SHFs will need access to credit facilities, although the farmers surveyed in this study were not comfortable with borrowing due to high-interest rates. This was also because of the short periods set for loan repayments by credit institutions. The government and the organisations working with smallholder farmers will need to make financial support available to SHFs to deal with the costs associated with drought coping and adaptation strategies. There is also a need for financial reserves and contingency mechanisms to accommodate smallholder farmers. This would ease severe drought losses in SHF agricultural production in the future.

Possible proactive drought coping and adaptation strategies for both crop and livestock farmers should be documented and made known to SHFs. Since the Department of Agriculture already conducts various events to help SHFs, providing practical training on drought coping measures should be considered especially by the Comprehensive Agricultural Support Programme (CASP), which provides targeted at supporting smallholders with a focus capacity building and training (Xaba and Dlamini, 2015). In addition, all organisations supporting SHFs should provide them with resources that will induce adoption activity and improve awareness of other available coping and adaptation strategies.

5.3. Further research

The study noted that smallholder farmers were still uninformed about drought and possible proactive strategies. Smallholder farmers still struggled due to several factors. Therefore, future research should examine the effectiveness of the identified coping and adaptation strategies. The study focused only on smallholder farmers, although all farmers suffer during drought. Future research should, therefore, include medium and commercial farmers. Lastly, there is also a need to study the effectiveness of institutions that support smallholder farmers during drought to find ways of increasing efficiency.

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